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② Gulf of Mexico Sales 131, 135, and 137:

③ Central, Western, and Eastern Planning Areas

(3A) Final Environmental Impact Statement

(4A) Volume I: Sections I through IV.C.

⑤

U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Region

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Gulf of Mexico
Sales 131, 135, and 137:

Central, Western, and Eastern Planning Areas

Final Environmental Impact Statement

Volume I: Sections I through IV.C.

Author

Minerals Management Service
Gulf of Mexico OCS Region

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REGIONAL DIRECTOR'S NOTE

This Final Environmental Impact Statement (EIS) covering the proposed OCS oil and gas lease sales in the Gulf of Mexico for 1991 is a product of the Minerals Management Service (MMS) in New Orleans, Louisiana. The proposed sales are Central Gulf of Mexico Sale 131 (March 1991), Western Gulf of Mexico Sale 135 (August 1991), and Eastern Gulf of Mexico Sale 137 (November 1991). This document includes the purpose and background of the proposed actions, the alternatives, the description of the affected environment, and the potential environmental impacts of the proposed actions and alternatives. Potential mitigating measures and their effects and potential cumulative impacts are also discussed. The visuals that are referred to in this document were distributed with the Draft EIS.

Additional copies of this Final EIS may be obtained from the MMS, Gulf of Mexico OCS Region, 1201 Elmwood Park Boulevard, New Orleans, Louisiana 70123-2394 or may be viewed at any of the EIS depository libraries listed on the back of Visual No. 1.

J. Rogers Pearcy

J. Rogers Pearcy
Regional Director
Minerals Management Service
Gulf of Mexico OCS Region

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COVER SHEET

Environmental Impact Statement for Proposed Central Gulf of Mexico OCS Lease Sale 131 (March 1991), Proposed Western Gulf of Mexico OCS Lease Sale 135 (August 1991), and Proposed Eastern Gulf of Mexico OCS Lease Sale 137 (November 1991)

Draft ( ) Final (x)

Type of Action:

Administrative (x) Legislative ( )

Area of Potential Impact:

Offshore Marine Environment and Coastal Counties/Parishes of Florida, Alabama, Mississippi, Louisiana, and Texas

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ABBREVIATIONS AND ACRONYMS

ac	acre
ACAMP	Alabama Coastal Area Management Program
AFB	Air Force Base
APD	Application for Permit to Drill
API	American Petroleum Institute
ARTC	Armament Research and Test Center
BACT	best available control technology
BAST	best available and safest technology
bbl	barrel
BBO	billion barrels of oil
bcf	billion cubic feet
BLM	Bureau of Land Management
BOD	biological oxygen demand
B.P.	before present
Btu	British thermal unit
CAA	Clean Air Act
Call	Call for Information and Nominations
CEE	Center for Environmental Education
CEI	Coastal Environments, Inc.
CEQ	Council on Environmental Quality
CER	categorical exclusion review
CERCLA	Comprehensive Environmental Compensation and Liability Act
CFR	Code of Federal Regulations
CGA	Clean Gulf Associates
CICO	Cook Inlet crude oil
cm	centimeter
CMP	coastal management program
COE	Corps of Engineers (U.S. Army)
COW	crude oil washing system
CPA	Central Planning Area
CSA	Continental Shelf Associates
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
dB	decibel
DER	Department of Environmental Regulation
DM	Departmental Manual
DNA	deoxyribonucleic acid, the genetic material in the nucleus of metazoan cells
DOC	Department of Commerce (U.S.)
DOCD	Development Operations Coordination Document
DOD	Department of Defense (U.S.)
DOE	Department of Energy (U.S.)
DOI	Department of the Interior (U.S.) (also: USDI)
DOT	Department of Transportation (U.S.)
DST	deep stratigraphic test
DWG	Dispersant Working Group
dwt	deadweight tonnage
EA	environmental assessment
EIS	environmental impact statement
EPA	Eastern Planning Area
ESP	Environmental Studies Program
FAA	free amino acid
FCF	Fishermen's Contingency Fund

FCMP	Florida Coastal Management Program
FERC	Federal Energy Regulatory Commission
FMC	Fisheries Management Council
FMP	Fishery Management Plan
FR	Federal Register
ft	foot
FWPCA	Federal Water Pollution Control Act
FWS	Fish and Wildlife Service
FY	fiscal year
G&G	geological and geophysical
GIWW	Gulf Intracoastal Waterway
GS	Geological Survey (U.S.) (also: USGS)
ha	hectare
HAPC	Habitat Area of Particular Concern
HOSS	High-Volume Open Sea Skimmer System
HUSS	Helicopter Underslung Sprayer System
IMCO	Intergovernmental Maritime Consultative Organization
in	inch
IPF	impact producing factor
ITL	Information to Lessees
ITS	Incidental Take Statement
km	kilometer
kn	knot
LCRP	Louisiana Coastal Resources Program
LOOP	Louisiana Offshore Oil Port
LOT	loaded on top
LNG	liquefied natural gas
LTL	Letter to Lessees and Operators
m	meter
MAFLA	Mississippi, Alabama, Florida
MAMES	Mississippi-Alabama Marine Ecosystems Study
MCP	Mississippi Coastal Program
MFCMA	Magnuson Fishery Conservation and Management Act of 1976
mi	mile
MIRG	Marine Industry Research Group
MMbbl	million barrels
MMcf	million cubic feet
MMS	Minerals Management Service
MOU	Memorandum of Understanding
mta	million metric tons annually
NAAQS	National Ambient Air Quality Standards
NAS	National Academy of Sciences
NCP	National Contingency Plan
NCSC	Naval Command System Center
NEPA	National Environmental Policy Act
NERBC	New England River Basins Commission
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NODC	National Oceanographic Data Center
NOI	Notice of Intent to Prepare an EIS
NPDES	National Pollution and Discharge Elimination System
NPS	National Park Service
NRC	National Research Council

NRT	National Response Team
NTL	Notice to Lessees
OCDM	Offshore Coastal Dispersion Model
OCRM	Office of Ocean and Coastal Resource Management
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OSC	On-Scene Coordinator
OSCP	Oil Spill Contingency Plan
OSRA	Oil Spill Risk Analysis
PAH	polynuclear aromatic hydrocarbon
PCB's	polychlorinated biphenyls
PINC	Potential Incident of Noncompliance
P.L.	Public Law
POD	Plan of Development/Production
POE	Plan of Exploration
ppm	parts per million
PSD	Prevention of Significant Deterioration
PWSA	Ports and Waterways Safety Act
RCP	Regional Contingency Plan
RD	Regional Director
RDTE	Research, Design, Testing, and Evaluation
ROTAC	Regional Operations Technology Assessment Committee
RRT	Regional Response Team
SIC	Standard Industrial Classification
SPCC	Spill Prevention Control and Countermeasure
SPR	Strategic Petroleum Reserve
SUSIO	State University System of Florida, Institute of Oceanography
SWAF	seawater-accommodated fractions
tcf	trillion cubic feet
TPA	Total Planning Area
TSP	total suspended particulates
TSS	traffic separation schemes
U.S.	United States
U.S.C.	United States Code
USAF	U.S. Air Force
USCG	U.S. Coast Guard
USDC	U.S. Department of Commerce (also: DOC)
USDI	U.S. Department of the Interior (also: DOI)
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
VOC	volatile organic compounds
VOSS	Vessel of Opportunity Skimming System
WPA	Western Planning Area
yd	yard
yr	year

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SUMMARY

This environmental impact statement (EIS) addresses three proposed Federal actions that will offer for lease areas on the Gulf of Mexico Outer Continental Shelf (OCS) that may contain economically recoverable oil and gas resources. The three proposed sales are part of the Department of the Interior's (DOI's) current 5-Year Program, which covers the period from mid-1987 to mid-1992. The proposed sales are scheduled to occur in 1991 and include lease blocks in the Central, Western, and Eastern Gulf of Mexico. The sale areas are depicted in Figure I-1 and lease blocks and lease status are shown on Visuals Nos. 1 and 1E.

Nearly 20,000 blocks will be available for lease under the three proposed actions, but only a small percentage are expected to actually be leased. The average number of blocks leased in individual Gulf of Mexico OCS lease sales since 1984 have been 431 (7 sales) in the Central Gulf, 279 (6 sales) in the Western Gulf, and 108 (3 sales) in the Eastern Gulf. Of the blocks that will actually be leased as a result of the three proposed actions, only a portion will eventually have drilling plans filed with the Minerals Management Service (MMS). When a drilling plan is proposed, MMS conducts a site-specific environmental assessment of the affects of the proposed activity.

The following are brief descriptions of the proposed actions, alternatives, mitigating measures, and issues addressed in this EIS.

Proposed Actions

Proposed Central Gulf Sale 131 is scheduled to be held in March 1991 and will offer approximately 5,204 unleased blocks (as of June 1990) comprising about 28.1 million acres in the Central Planning Area (CPA). This area includes acreage located from 4.8 to 354 kilometers (km) offshore in water depths ranging from 4 to 3,425 meters (m). There are no areas deferred from the CPA at this time, but there are alternatives to the proposed action and protective mitigating measures available for adoption as described below.

Proposed Western Gulf Sale 135 is scheduled to be held in August 1991 and will offer approximately 4,792 unleased blocks (as of May 1990), comprising about 26.3 million acres in the Western Planning Area (WPA). This area is located from 14 to 357 km offshore in water depths ranging from 8 to over 3,000 m. Excluded from this proposed action are Blocks A-375 (East Flower Garden Bank) and A-398 (West Flower Garden Bank) in High Island Area, East Addition, South Extension, which were deferred because of the environmentally sensitive nature of the biological communities located in the blocks. There are also alternatives to the proposed action, and protective mitigating measures available for adoption as described below.

Proposed Eastern Gulf Sale 137 is scheduled to be held in November 1991 and will offer approximately 8,356 unleased blocks (as of June 1990), comprising about 47.5 million acres in the Eastern Planning Area (EPA). This area is located from 16 to 483 km offshore in water depths ranging from 10 to over 3,400 m. Excluded from this proposed action are the areas approximately 32-48 km (20-30 mi) seaward of the western coastline of Florida, extending from the Apalachicola/Cape San Blas area on the north to latitude 26°N to the south, as well as 23 blocks centered around the Florida Middle Ground (both deferred at the time of the 5-Year Program Decision), and the region south of latitude 26°N to the State waters north of the Keys and west to approximately longitude 86°W. There are also alternatives to the proposed action and protective mitigating measures available for adoption as described below.

Issues, Alternatives, and Potential Mitigating Measures

A scoping process (Section I.B.2.) was used to obtain information and comments on the proposed actions from the affected States, Federal agencies, the petroleum industry, public interest groups, and concerned individuals. The input from these sources aided in the identification of significant issues, possible alternatives to the proposed actions, and potential mitigating measures. The results of this process and subsequent evaluations are as follows.

Significant Issues

The potential impacts of the three proposed actions to the sensitive resources and activities listed in Table S-1 are analyzed in Section IV.D. The basic assumptions, estimates, and development scenarios used as the basis for these analyses are presented in Section IV.A. There are three separate scenarios (levels of activity) and analyses provided for each sensitive resource: the Base Case, the Cumulative Scenario, and the High Case. The scenarios represent assumptions and estimates on a set of future conditions that are considered reasonably foreseeable and suitable for presale impact analyses. The Base Case estimates are based on the mean or "expected" case values of total undiscovered, unleased hydrocarbon resources. The Base Case estimates are used for the principal impact analyses of the proposed sales and for the cumulative analyses, which also include the impacts of non-OCS-related activities. The High Case is used in supplemental analyses for comparative purposes. Table S-2 provides resource and offshore infrastructure estimates for the Base Case. Tables S-3, S-4, and S-5 provide a listing of the levels of impacts to the above sensitive resources as estimated under the various scenario analyses and alternative analyses in Section IV.D. Table S-6 contains the definitions of the impact levels displayed in the previous tables.

Alternatives

Proposed Central Gulf Sale 131

Alternative A (The Proposed Action): The proposed action is an offer to lease all unleased areas within the CPA for oil and gas exploration and development. It is estimated that the proposal could result in the production of 0.13 billion bbl of oil (BBO) and 1.21 trillion cubic feet (tcf) of gas after leases are issued and exploration occurs.

Alternative B (Delete Biologically Sensitive Offshore Habitats): This alternative would delete all unleased blocks of the 167 total blocks on or near biologically sensitive areas of the topographic features in the Central Gulf.

Alternative C (No Action): This alternative equates to cancellation of the sale. Potential impacts and oil and gas production, which could result from the proposed action, would not occur. Other potential alternative energy resources that might be used to replace this lost resource production have been discussed in Appendix F.

Proposed Western Gulf Sale 135

Alternative A (The Proposed Action): The proposed action is an offer to lease all unleased areas within the WPA for oil and gas exploration and development, with the exception of the following blocks excluded from the Call: Block A-375 (East Flower Garden Bank) and Block A-398 (West Flower Garden Bank) in High Island Area, East Addition, South Extension. It is estimated that the proposal could result in the production of 0.05 BBO and 0.72 tcf of gas.

Alternative B (Delete Biologically Sensitive Offshore Habitats): This alternative would delete all unleased blocks of the 200 total blocks on or near biologically sensitive areas of the topographic features in the Western Gulf.

Alternative C (No Action): This alternative equates to cancellation of the sale. Potential impacts and oil and gas production, which could result from the proposed action, would not occur. Other potential alternative energy resources that might be used to replace this lost resource production have been discussed in Appendix F.

Proposed Eastern Gulf Sale 137

Alternative A (The Proposed Action): The proposed action is an offer to lease all unleased areas within the EPA for oil and gas exploration and development, with the exception of the following areas excluded from the Call: a strip approximately 32-48 km (20-30 mi) seaward of the western coastline of Florida, extending from the Apalachicola/Cape San Blas area on the north to latitude 26°N to the south, as well as 23 blocks centered around the Florida Middle Ground (both deferred at the time of the 5-Year Program Decision), and the region south of latitude 26°N to the State waters north of the Keys and west to approximately longitude 86°W. It is estimated that the proposal could result in the production of 0.04 BBO and 0.06 tcf of gas.

Alternative B (Delete Inner Cape San Blas Blocks): This alternative would remove from consideration for leasing purposes the area within the EPA known as the Inner Cape San Blas Blocks. This area includes 47 blocks adjacent to the State/Federal boundary from Cape San Blas west to Panama City, Florida. This alternative would provide a buffer zone between potential oil and gas activities and the adjacent coastal area, as requested by the State of Florida.

Alternative C (Delete Naval Operations Area): This alternative would remove from consideration for leasing purposes 244 blocks in the U.S. Navy's Carrier Operations Area in the northwestern portion of the EPA. This alternative would preclude potential multiple-use conflicts between OCS activities and Naval operations.

Alternative D (Delete Drone Operations Area): This alternative would remove from consideration for leasing purposes 60 whole or split blocks in the area where the U.S. Air Force uses drone aircraft for military training exercises. This area is located in the northeastern portion of the EPA, in the nearshore waters off Panama City. This alternative would preclude potential multiple-use conflicts between OCS activities and drone operations.

Alternative E (Delete the Panhandle Buffer Zone): This alternative would remove from consideration for leasing purposes 642 unleased blocks, or 3.5 million acres, in an area some 50 km (30 mi) seaward of the Federal/State boundary off Gulf County, Florida, and extending westward to the boundary of the EPA and CPA off Baldwin County, Alabama (Figure II-9).

Alternative F (Delay the Sale): This alternative would delay the sale of unleased blocks in the EPA. The basic assumption is that all impacts associated with the action would be delayed for some period of time.

Alternative G (No Action): This alternative equates to cancellation of the sale. Potential impacts and oil and gas production, which could result from the proposed action, would not occur. Other potential alternative energy resources that might be used to replace this lost resource production have been discussed in Appendix F.

Potential Mitigating Measures

Four standard stipulations have been applied to appropriate Gulf OCS leases for many years with considerable success. These four established stipulations, as well as two more recently developed stipulations on oil-spill response, are potential mitigating measures for the proposed sales. The potential stipulations are as follows:

- Central Gulf Sale 131
    - Live-bottom (Pinnacle Trend) Stipulation
    - Topographic-features Stipulation
    - Archaeological-resources Stipulation
    - Military-areas Stipulation
- Western Gulf Sale 135
    - Topographic-features Stipulation
    - Archaeological-resources Stipulation
    - Military-areas Stipulation
- Eastern Gulf Sale 137
    - Live-bottom Stipulation
    - Archaeological-resources Stipulation
    - Oil-spill Response Stipulations
    - Military-areas Stipulations

Live-bottom Stipulations: Two areas within the Central and Eastern Gulf are considered for protection with the implementation of the Live-bottom Stipulation.

The potential Live-bottom Stipulation for Central Gulf Sale 131 covers the pinnacle trend area of the CPA. The northeastern portion of the Central Gulf contains a band of pinnacles between 67 and 109 m (220-360 ft) in depth, which extends into the northwestern portion of the Eastern Gulf. The pinnacles appear to be dead reefal structures with limited biotal coverage, but they may provide structural habitat for a variety of pelagic fish. A live-bottom stipulation has been made a part of previously issued leases and is a part of many active leases in the Central Gulf. This stipulation has been deemed necessary in the past since the position and extent of many of the sensitive and high-value, live-bottom areas were poorly known. These areas are, for the most part, patchy and scattered. This stipulation has not prevented the recovery of oil and gas resources in the past, but it has protected valuable and sensitive biological resources.

The potential Live-bottom Stipulation for Eastern Gulf Sale 137 covers all blocks to depths of 100 m. The offshore areas of the Eastern Gulf are scattered with live-bottom communities comprised of sponges, octocorals, gorgonians, and a few hard corals. The actual extent and location of these live bottoms are unknown. This stipulation is proposed because of the scattered nature of these areas, the sensitivity and value of live bottoms, and the potential for impact to the live bottoms from leasing activities.

Topographic-features Stipulation: The topographic features of the Central and Western Gulf provide habitat for coral and coral-community organisms. These communities would be severely and adversely impacted by unrestricted oil and gas activities resulting from the proposed actions, in the event such activities took place on, or in proximity to, them. The Department has recognized this problem for some years, and since 1973 stipulations have been made a part of leases for blocks on or near enough to these biotic communities for the nearby oil and gas activities to have an impact on them. The Topographic-features Stipulation was developed through close consultation and coordination between various State, Federal, and local agencies, and it uses the results of topographic-features studies and industry monitoring reports.

Archaeological-resource Stipulation: This stipulation was first implemented in 1973 in response to the requirements of the National Historic Preservation Act of 1966, as amended. This Act states, in effect, that any Federal agency, prior to approving federally permitted or funded undertakings, must take into consideration the effect of that undertaking on any National Register or National Register eligible property. Implied in this legislation and Executive Order 11593 is that an effort be made to locate such sites prior to development of an area. The OCSLA, as amended, specifically states in Section 11 (g)(3) that "such exploration (oil and gas) will not disturb any site, structure, or object of historical or archaeological significance."

The potential stipulation includes a clause that requires an archaeological assessment of geophysical survey data within areas where the Regional Director has a reason to believe that an archaeological resource is likely to exist. The Archaeological-resource Stipulation has reduced the potential impacts to archaeological sites from oil and gas development by allowing detection of potential sites prior to development, thereby making avoidance possible.

Military-areas Stipulations: A standard Military-areas Stipulation has been applied to all blocks leased in military areas in the Gulf of Mexico since 1977. The stipulation contains three significant requirements including notification to the military by the operator prior to conducting activities in an area. Blocks leased in particular areas of the Eastern Gulf have an additional clause, which addresses evacuation during military testing, attached to the standard stipulation. Certain areas in the EPA are also subject to a second military stipulation that concerns restrictions on the location and timing of exploration activities within the area.

Oil-spill Response Stipulations: There are two Oil-spill Response Stipulations offered as potential mitigating measures in the Eastern Gulf. These stipulations are intended to minimize the risk of oil spills reaching Florida State waters by requiring the staging of state-of-the-art mechanical oil-spill response equipment within specified timeframes and by requiring that oil-dispersant chemicals and equipment be maintained in a state of readiness. The first stipulation applies to 168 blocks, referred to as the Panhandle blocks, located in a 32-km (20-mi) zone adjacent to the State/Federal boundary between the Florida-Alabama State line and Panama City, Florida. These 168 blocks are made up of two areas as depicted on Figure II-3. The shoreward area is subject to more stringent requirements under the stipulation than the area farther from shore. The second stipulation applies to two areas known as the Inner and Outer Cape San Blas Blocks (47 and 64 blocks, respectively) as depicted on Figure II-4. The stipulation is identical for both of the areas, but the areas are identified separately because the inner area is offered as a deletion alternative as described above.

The stipulations and the discussions of their effects are located in Section II.A.1.c., II.B.1.c., and II.C.1.c.

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Table S-1

Sensitive Resources and Activities

Central Gulf Sale 131

Impacts on Sensitive Coastal Habitats
(a) Coastal Barriers
(b) Wetlands
Impacts on Sensitive Offshore Habitats and Communities
(a) Live Bottoms (Pinnacle Trend)
(b) Deep-water Benthic Communities
(c) Topographic Features
Impacts on Water Quality
(a) Coastal and Nearshore
(b) Offshore
Impacts on Air Quality
Impacts on Endangered and Threatened Species
(a) Kemp's Ridley Sea Turtle
(b) Loggerhead Sea Turtle
(c) Great Whales
(d) Piping Plover
(e) Brown Pelican
(f) Gulf Sturgeon
Impacts on Marine Mammals
Impacts on Coastal and Marine Birds
Impacts on the Commercial Fishing Industry
Impacts on Recreational Beach Use
Impacts on Archaeological Resources
(a) Historic
(b) Prehistoric

Western Gulf Sale 135

Impacts on Sensitive Coastal Habitats
(a) Coastal Barriers
(b) Wetlands
Impacts on Sensitive Offshore Habitats and Communities
(a) Deep-water Benthic Communities
(b) Topographic Features
Impacts on Water Quality
(a) Coastal and Nearshore
(b) Offshore
Impacts on Air Quality
Impacts on Endangered and Threatened Species
(a) Kemp's Ridley Sea Turtle
(b) Loggerhead Sea Turtle
(c) Great Whales
(d) Piping Plover
(e) Brown Pelican
(f) Eskimo Curlew
(g) Whooping Crane
Impacts on Marine Mammals
Impacts on Coastal and Marine Birds
Impacts on the Commercial Fishing Industry
Impacts on Recreational Beach Use
Impacts on Archaeological Resources
(a) Historic
(b) Prehistoric

Eastern Gulf Sale 137

Impacts on Sensitive Coastal Habitats
(a) Coastal Barriers
(b) Wetlands
(c) Seagrasses
Impacts on Sensitive Offshore Habitats and Communities
(a) Live Bottoms
(b) Deep-water Benthic Communities
Impacts on Water Quality
(a) Coastal and Nearshore
(b) Offshore
Impacts on Air Quality
Impacts on Endangered and Threatened Species
(a) Kemp's Ridley Sea Turtle
(b) Loggerhead Sea Turtle
(c) Great Whales
(d) Piping Plover
(e) Florida Manatee
(f) Gulf Sturgeon
Impacts on Marine Mammals
Impacts on Coastal and Marine Birds
Impacts on the Commercial Fishing Industry
Impacts on Recreational Resources, Activities, and Associated Tourism
(a) Beach Use
(b) Recreational Fishing
Impacts on Archaeological Resources
(a) Historic
(b) Prehistoric

Table S-2

Resource and Offshore Infrastructure Estimates: Sales 131, 135, and 137

	Central Planning Area Sale 131 Base Case	Western Planning Area Sale 135 Base Case	Eastern Planning Area Sale 137 Base Case
Acreage Available for Leasing[1] (million of acres)	28.1	26.3	47.5
Resources Expected to be Developed[2]			
Oil (billion bbl)	0.13	0.05	0.04
Gas (tcf)	1.21	0.72	0.06
Offshore Infrastructure			
Exploration and Delineation Wells	310	200	90
Platforms	25	15	10
Development Wells	230	110	50
Pipelines (km)	201	121	80

Note: Tables IV-1, IV-2, and IV-3 include estimates for the Cumulative and High Case Analyses. These analyses are described in Sections IV.D.1. (Central Gulf Sale 131), IV.D.2. (Western Gulf Sale 135), and IV.D.3. (Eastern Gulf Sale 137).

[1] Unleased acreage available for leasing (deferred acreage not included) as of June 1990 for the Central Gulf sale, as of May 1990 for the Western Gulf sale, and as of June 1990 for the Eastern Gulf sale.
[2] The methodology used to estimate resources is explained in Appendix C.

Source: USDI, Minerals Management Service, 1989, Gulf of Mexico OCS Region estimates.

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Table S-3

Comparison and Summary of Impact Levels[1] for Alternatives A-C in the Central Planning Area (Sale 131)

Resource Category	Alternative A[2]					
	Base Case Without Potential Mitigating Measures	Base Case With Potential Mitigating Measures	Cumulative	High Case	Alternative B[3]	Alternative C[4]
Sensitive Coastal Habitats						
Coastal Barriers	VL		VH	L	VL	NE
Wetlands	VL		VH	VL	VL	NE
Sensitive Offshore Habitats and Communities						
Live-bottom Areas (Pinnacle Trend)	L	VL	M	M	L	NE
Deep-water Benthic Communities (Low Density)	L		L	L	L	NE
Deep-water Benthic Communities (High Density-"Bush Hill")	M		M	M	M	NE
Topographic Features	VH	VL	VH	VH	VL	NE
Water Quality						
Coastal and Nearshore	L[a]		H[b]	L[a]	L[a]	NE
Offshore	L		H	L	L	NE
Air Quality	VL[c]		M	VL[c]	VL[c]	NE
Endangered and Threatened Species						
Kemp's Ridley Sea Turtle	M		VH	M	M	NE
Loggerhead Sea Turtle	L		H	L	L	NE
Great Whales	L		L	L	L	NE
Piping Plover	L		H	L	L	NE
Brown Pelican	L		H	L	L	NE
Gulf Sturgeon	L		VH	L	L	NE
Marine Mammals	L		L	L	L	NE
Coastal and Marine Birds	VL		M	VL	VL	NE
Commercial Fishing Industry	L		H	L	L	NE
Recreational Beach Use	L		M	L	L	NE
Archaeological Resources						
Historic	M	M	M	M	M	NE
Prehistoric	VL	VL	VH	VL	VL	NE

VH - Very High	M - Moderate	VL - Very Low
H - High	L - Low	NE - No Effect

[1] For definitions of levels of impacts, see Table S-6.
[2] Alternative A - The Proposed Action.
[3] Alternative B - Delete Biologically Sensitive Offshore Habitats.
[4] Alternative C - No Action.

[a] Moderate in the lower Mississippi River Delta area.
[b] Moderate in Mississippi and Alabama and in open nearshore waters.
[c] Moderate in St. Bernard, Plaquemines, St. Mary, Lafourche, St. Charles, Jefferson, and Orleans Parishes.

Table S-4

Comparison and Summary of Impact Levels[1] for Alternatives A-C in the Western Planning Area (Sale 135)

	Alternative A[2]					
Resource Category	Base Case Without Potential Mitigating Measures	Base Case With Potential Mitigating Measures	Cumulative	High Case	Alternative B[3]	Alternative C[4]
Sensitive Coastal Habitats						
Coastal Barriers	VL		M	VL	VL	NE
Wetlands	VL		M	L	VL	NE
Sensitive Offshore Habitats and Communities						
Deep-water Benthic Communities (Low Density)	L		L	L	L	NE
Deep-water Benthic Communities (High Density-"Bush Hill")	M		M	M	M	NE
Topographic Features	VH	VL	VH	VH	VL	NE
Water Quality						
Coastal and Nearshore	VL		H[a]	L	L	NE
Offshore	L		H	L	L	NE
Air Quality	VL[b]		M	VL[b]	VL[b]	NE
Endangered and Threatened Species						
Kemp's Ridley Sea Turtle	M		VH	M	M	NE
Loggerhead Sea Turtle	L		H	L	L	NE
Great Whales	L		L	L	L	NE
Piping Plover	L		H	L	L	NE
Brown Pelican	L		H	L	L	NE
Eskimo Curlew	M		H	M	M	NE
Whooping Crane	M		M	M	M	NE
Marine Mammals	L		L	L	L	NE
Coastal and Marine Birds	VL		M	VL	VL	NE
Commercial Fishing Industry	L		H	L	L	NE
Recreational Beach Use	L		M	L	L	NE
Archaeological Resources						
Historic	M	M	M	M	M	NE
Prehistoric	VL	VL	VH	VL	VL	NE

VH - Very High
H - High
M - Moderate
L - Low
VL - Very Low
NE - No Effect

[1] For definitions of levels of impacts, see Table S-6.

[2] Alternative A - The Proposed Action.

[3] Alternative B - Delete Biologically Sensitive Offshore Habitats.

[4] Alternative C - No Action.

[a] Moderate in nearshore open water.

[b] Low in Cameron, Nueces, Galveston, Jefferson, and Brazoria Counties in Texas.

Table S-5

Comparison and Summary of Impact Levels[1] for Alternatives A-G in the Eastern Planning Area (Sale 137)

	Alternative A[2]									
Resource Category	Base Case Without Potential Mitigating Measures	Base Case With Potential Mitigating Measures	Cumulative	High Case	Alternative B[3]	Alternative C[4]	Alternative D[5]	Alternative E[6]	Alternative F[7]	Alternative G[8]
Sensitive Coastal Habitats										
Coastal Barriers	VL		H	VL	VL	VL	VL	VL	VL	NE
Wetlands	VL		L	VL	VL	VL	VL	VL	VL	NE
Seagrasses	L	VL	H	L	L	L	L	L	L	NE
Sensitive Offshore Habitats and Communities										
Live-bottom Areas	M	VL	VH	H	M	M	M	M	M	NE
Deep-water Benthic Communities (Low Density)	L		L	L	L	L	L	L	L	NE
Deep-water Benthic Communities (High Density - "Bush Hill")	M		M	M	M	M	M	M	M	NE
Water Quality										
Coastal and Nearshore	VL[a]		M[b]	VL[c]	VL[a]	VL[a]	VL[a]	VL[a]	VL[a]	NE
Offshore	L		H	L	L	L	L	L	L	NE
Air Quality	VL[d]		M	VL[d]	VL[d]	VL[d]	VL[d]	VL[d]	VL[d]	NE
Endangered and Threatened Species										
Kemp's Ridley Sea Turtle	M		VH	M	M	M	M	M	M	NE
Loggerhead Sea Turtle	L		H	L	L	L	L	L	L	NE
Great Whales	L		L	L	L	L	L	L	L	NE
Piping Plover	L		H	L	L	L	L	L	L	NE
Florida Manatee	M		H	M	M	M	M	M	M	NE
Gulf Sturgeon	L		VH	L	L	L	L	L	L	NE
Marine Mammals	L		L	L	L	L	L	L	L	NE
Coastal and Marine Birds	VL		M	VL	VL	VL	VL	VL	VL	NE
Commercial Fishing Industry	L		H	L	L	L	L	L	L	NE
Resources/Recreational Activities, and Associated Tourism										
Beach Use	VL		L	VL	VL	VL	VL	VL	VL	NE
Recreational Fishing	VL		L	VL	VL	VL	VL	VL	VL	NE
Archaeological Resources										
Historic	VL	VL	VL	VL	VL	VL	VL	VL	VL	NE
Prehistoric	VL	VL	H	VL	VL	VL	VL	VL	VL	NE

VH - Very High
H - High
M - Moderate
L - Low
VL - Very Low
NE - No Effect

[1] For definitions of levels of impacts, see Table S-6.
[2] Alternative A - The Proposed Action.
[3] Alternative B - Delete Inner Cape San Blas Blocks.
[4] Alternative C - Delete Naval Operations Area.
[5] Alternative D - Delete Drone Runway Area.
[6] Alternative E - Delete the Panhandle Buffer Zone.
[7] Alternative F - Delay the Sale.
[8] Alternative G - No Action.

[a] Moderate at Port Manatee.
[b] Low in nearshore open water.
[c] Low in a few locations.
[d] Moderate in Escambia County and low in Hillsborough, Pinellas, Hernando, Wakulla, and Jefferson Counties in Florida.

Table S-6

Definitions Assumed in Impact Assessment

	Very High	High	Moderate	Low	Very Low
Sensitive Coastal Habitats **Coastal Barriers**	The coastline migrates landward more than 7.5 m/yr on average or the landform loses 0.25% or more of its land mass annually.	Either the coastline erodes more than 3 m/yr on average or the landform loses between 0.1% and 0.24% of its land mass annually.	Either the coastline erodes between 2 and 3 m/yr on average or the landform loses between 0.05% and 0.09% of its land mass annually.	The coastline erodes at less than 2 m/yr.	Minimal disturbance of coastal barrier landform occurs such that there is no net erosion or landloss.
Wetlands	Either 0.25%/yr of the habitat within a coastal physiographic unit or 1,000 ha/yr of habitat, whichever quantity is less, are permanently converted to other habitat types (open water or spoil bank) or degraded to the extent that there is impairment of wetland functioning within the ecosystem.	Either 0.125%/yr of the habitat or 500 ha/yr, whichever quantity is less, are permanently converted to other habitat types or degraded to the extent that there is impairment of wetland functioning within the ecosystem.	Either 0.05%/yr of the habitat or 200 ha/yr, whichever quantity is less, are permanently converted to other habitat types or degraded to the extent that there is impairment of wetland functioning within the ecosystem.	Less than 0.05%/yr or 200 ha/yr, whichever quantity is less, permanent loss of wetland habitat occurs but significant amounts of temporary dieback of wetlands vegetation lasting for 2 to 3 years.	Less than 0.025%/yr or 100 ha/yr, whichever quantity is less, permanent loss of wetland occurs. Minor amounts of temporary dieback of wetlands vegetation lasting for 2 to 3 years.
Seagrasses	Complete loss or major changes in essential, identifiable system elements or relationships are at a regional scale for time periods greater than 10 years.	Loss of elements and/or relationships occur. At a regional scale, the time period of the alteration is greater than 5-10 years; at the local scale, the time period is greater than 10 years.	Some substantial losses of portions of ecosystem elements, but general relationships will not be permanently altered. At a regional scale, the time period of the alteration is 2-5 years; at the local scale, the time period is 5-10 years.	Few losses of elements; general relationships will not be permanently altered. At the regional scale, the time period of the alteration is 6 months-2 years; at the local scale, the time period is 2-5 years.	Interference to established relationships of the seagrass ecosystem such that the system may exhibit the possible loss of a few elements at the regional or local scale, but no interference to the general system performance.
Sensitive Offshore Habitats and Communities **Live-bottom Communities**	Complete loss or major changes in essential, identifiable system elements or relationships at a regional scale for time periods greater than 10 years.	Loss of elements and/or relationships occur. At a regional scale, the time period of the alteration is greater than 5-10 years; at the local scale, the time period is greater than 10 years.	Some substantial losses of portions of ecosystem elements, but general relationships will not be permanently altered. At a regional scale, the time period of the alteration is 2-5 years; at the local scale, the time period is 5-10 years.	Low or few losses of system elements; general relationships will not be permanently altered. At the regional scale, the time period of the alteration is 6 months-2 years; at the local scale, the time period is 2-5 years.	The system may exhibit the possible loss of a few elements, but no interference to the general system performance.
Chemosynthetic Communities	Complete loss or major changes in essential, identifiable system elements or relationships at a regional scale for time periods greater than 10 years.	Substantial loss of elements and/or relationships occur. At a regional scale, the time period of the alteration is greater than 5-10 years; at the local scale, the time period is greater than 10 years.	Some substantial losses of portions of ecosystem elements, but general relationships will not be permanently altered. At a regional scale, the time period of the alteration is 2-5 years; at the local scale, the time period is 5-10 years.	Low or few losses of elements; general relationships will not be permanently altered. At the regional scale, the time period of the alteration is 6 months-2 years; at the local scale, the time period is 2-5 years.	Possible loss of a few elements at the regional or local scale, but no interference to the general system performance.
Topographic Features	Complete loss or major changes in essential, identifiable system elements or relationships at a regional scale for time periods greater than 10 years.	Substantial loss of elements and/or relationships occur. At a regional scale, the time period of the alteration is greater than 5-10 years; at the local scale, the time period is greater than 10 years.	Substantial losses of portions of ecosystem elements, but general relationships will not be permanently altered. At a regional scale, the time period of the alteration is 2-5 years; at the local scale, the time period is 5-10 years.	Low or few losses of elements; general relationships will not be permanently altered. At the regional scale, the time period of the alteration is 6 months-2 years; at the local scale, the time period is 2-5 years.	The system may exhibit the loss of a few elements at the regional or local scale, but no interference to the general system performance. Recovery of the system to pre-interference conditions is rapid.

Table S-6. Definitions Assumed in Impact Assessment (continued)

	Very High	High	Moderate	Low	Very Low
Water Quality	Complete loss or major changes from ambient or pristine water quality characteristics. Essential uses of the affected waters are destroyed. This disturbance is at a regional or local scale for time periods greater than ten years.	Some deleterious changes from background or pristine water quality characteristics that last for time periods greater than two years and less than ten years. One or more essential uses of the affected waters are disrupted.	Some changes in water quality characteristics from background levels, so that some uses of the affected waters will be partially lost. The time period of the disturbance at the regional scale or local scale is 6 months to two years.	Some measure of water quality characteristics changing from background levels either at the local or regional scale but there is no effect to the users of the water. The time period of the disturbance is from six weeks to six months.	Some measure of water quality characteristics changing from background levels at the local only but there is no effect to the users of the water. The time period of the disturbance is less than six weeks.
Air Quality	Offshore or onshore sources significantly increase levels of criteria pollutants such that non-attainment areas will be degraded further or attainment and PSD areas are significantly degraded.*	Offshore or onshore sources increase levels of criteria pollutants such that nonattainment areas would be degraded less than significantly and attainment and PSD areas would be degraded.*	Offshore or onshore sources increase levels of criteria pollutants such that nonattainment areas could experience minor degradation and attainment and PSD areas will not degrade significantly.*	Offshore or onshore sources increase levels of criteria pollutants such that nonattainment areas will not be degraded further and attainment and PSD areas will undergo insignificant increases in levels of criteria pollutants.*	Offshore or onshore sources increase levels of criteria pollutants such that nonattainment areas will not be degraded further and attainment and PSD areas will undergo negligible increases in levels of criteria pollutants.*
Protected Species	The complete loss in a regional population, or critical habitat. Recovery to pre-interference conditions may not occur and if recoverable, would require 3 or more generations.	The partial loss of a regional population or major portions of critical habitat. Recovery to pre-interference conditions is probable in 2 to 3 generations.	The partial loss of a regional population or minor portions of critical habitat. Recovery to pre-interference conditions is probable 1 to 2 generations.	The partial loss of a regional population, but no loss of critical habitat. Recovery to pre-interference conditions is probable within one generation.	The partial loss of a local population, with no loss of critical habitat. Recovery to pre-interference conditions is probable in less than 1 generation
Marine Mammals	The complete loss of a regional population. Recovery to pre-interference conditions may not occur and recovery time would require 3 or more generations.	The partial loss of a regional population or entire local population which would be recoverable to pre-interference conditions in 2 to 3 generations.	The partial loss of a regional or local population which would probably be recoverable to pre-interference conditions in 1 to 2 generations.	The partial loss of a local population which would probably be recoverable to pre-interference conditions within one generation.	A few losses to a local population which would probably recover to pre-interference conditions in less than 1 generation
Coastal and Marine Birds	A population or species decline, resulting in a change in distribution and/or abundance beyond which recruitment would not return the population or species to its former level in fewer than three generations. This will affect the regional population.	A population or species decline, resulting in a change in distribution and/or abundance by which recruitment will return the population or species to its former level within two to three generations. This will affect the regional population.	A population or species decline, resulting in a change in distribution and/or abundance by which recruitment will return the population or species to its former level within one to two generations. It is doubtful that this will affect the regional population.	A population or species decline, resulting in a change in distribution and/or abundance by which recruitment will return the population or species to its former level within one generation. This will not affect the regional population.	No discernible decline in a population or species, resulting in no change in distribution and/or abundance. Individuals experiencing sublethal effects will recover to their preimpact condition in less than one generation. This will not affect the regional population.
Commercial Fishing Industry	A population of commercial importance, the quality of an essential habitat, or the activity of commercial fishing declines, resulting in a change beyond which recruitment would not return the population, habitat, or activity to its former level and/or condition in fewer than three generations. This will affect the industry on a regional scale.	A population of commercial importance, the quality of an essential habitat, or the activity of commercial fishing declines, resulting in a change by which recruitment will return the population, habitat, or activity to its former level and/or condition within two to three generations. This will affect the industry on a regional scale.	A population of commercial importance, the quality of an essential habitat, or the activity of commercial fishing declines, resulting in a change by which recruitment will return the population, habitat, or activity to its former level and/or condition within one to two generations. It is doubtful that this will affect the industry on a regional scale.	A population of commercial importance, the quality of an essential habitat, or the activity of commercial fishing declines, resulting in a change by which recruitment will return the population, habitat, or activity to its former level and/or condition within one generation. This will not affect the industry on a regional scale.	No discernible decline in a population of commercial importance, the quality of an essential habitat, or in the activity of commercial fishing. Individual adult finfish or shellfish experiencing sublethal effects will recover to their preimpact condition in less than one generation. This will not affect the industry on a regional scale.

Table S-6. Definitions Assumed in Impact Assessment (continued)

	Very High	High	Moderate	Low	Very Low
Recreational Beach Use and Associated Tourism	Complete loss of recreational beaches or major adverse changes in the quantity of quality of recreational beaches so as to preclude recreational use and associated tourism at a regional scale (Planning Area) for time periods greater than one year. Complete and irreversible destruction of community or established parks will occur.	Substantial losses of recreational beach use and associated tourism. At a regional scale, the time period of the disturbance is greater than one peak use season; At the local scale (county, or community level), the time period is greater than one year.	Some substantial losses of recreational beach use and associated tourism, but recreational beaches will not be permanently altered. At a regional scale, the time period of the disturbance is one peak use season; At the local scale, the time period is more than one peak use season.	Few losses of recreational use or associated tourism but adverse impacts to beach amenities. At the regional scale, the time period of the disturbance is intermittent; and at the local scale, it could be chronic.	Interference with the quality of recreational beaches may be perceptible but is unlikely to generate increased beach maintenance or affect the amount or enjoyment of recreational use and associated tourism either regionally or locally.
Marine Recreational Fishing Impact Definitions	Major loss of catch or major changes in effort are identifiable at the regional scale for time periods greater than 10 years.	Loss of catch and effort identifiable at the regional scale for time periods of 5-10 years; or at the local scale for a time period greater than 10 years.	Loss of catch and effort at the regional scale for time periods of 2-5 years; or at the local scale for a time period of 5-10 years.	Loss of catch and effort for over one fishing season at the regional scale, but may result in loss of catch and effort at specific sites for periods from one to 5 years.	Interference with marine recreational fishing effort or catch at the regional or local level is unlikely for an extended period of time however disturbance or decrease in enjoyment of individual fishing trips may occur from time to time.
Archaeology	Unique archaeological information contained within one site or resource is destroyed, or some of the unique information from several related sites or resources is destroyed to the extent that the advancement of archaeological knowledge is impaired.	Some of the unique information contained within one site or resource, or significant,* but not unique, information from several related sites or resources is destroyed to the extent that the elaboration of existing archaeological knowledge is impaired.	Archaeological site(s) or resource(s) is (are) affected to the extent that the loss of archaeological data are not significant.*	Archaeological sites or resources are affected to the extent that impacts are temporary and reversible.	Archaeological sites or resources are affected to the extent that little damage occurs.

*Significant levels are defined by regulations 40 CFR 52.21 and 30 CFR 250.57.

**A generation is the term of years accepted as the average period between the birth of the parents and the birth of their offspring.

***Significance levels are defined by National Register criteria as described in 36 CFR 60.4.

THE PROPOSED ACTIONS I

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SECTION I

THE PROPOSED ACTIONS

I. THE PROPOSED ACTIONS

A. PURPOSE, NEED, AND DESCRIPTION

The purpose of the three proposed Federal actions addressed in this Draft Environmental Impact Statement (EIS) is the offering for lease of areas on the Gulf of Mexico Outer Continental Shelf (OCS) for the exploration and development of recoverable oil and gas resources. The Department of the Interior (DOI) is required under the Outer Continental Shelf Lands Act (OCSLA), as amended, to manage the leasing, exploration, development, and production of oil and gas resources on the OCS. The Secretary of the Interior (Secretary) oversees the OCS oil and gas program and is required to balance orderly resource development with protection of the human, marine, and coastal environments while simultaneously ensuring that the public receives an equitable return for these resources and that free-market competition is maintained.

The three proposed sales are part of DOI's current 5-Year Program, which covers the period from mid-1987 to mid-1992. The proposed sales are scheduled to occur in 1991 and include lease blocks in the Central, Western, and Eastern Gulf of Mexico. The sale areas are depicted in Figure I-1 and lease blocks and lease status are shown on Visuals Nos. 1 and 1E. Nearly 20,000 blocks will be available for lease under the three proposed actions, but only a small percentage are expected to actually be leased. The average number of blocks leased in individual Gulf of Mexico OCS lease sales since 1984 have been 431 (7 sales) in the Central Gulf, 279 (6 sales) in the Western Gulf, and 108 (3 sales) in the Eastern Gulf.

The following are brief descriptions of the proposed actions, alternatives, and potential mitigating measures. Also provided are assumptions and estimates of the amounts, locations, and timing for OCS exploration, development, and production operations that are used in the analysis of potential impacts from the proposed actions (Base Case). More detail is available elsewhere in the document (alternatives, Section I.B.2.a.; potential mitigating measures, Section I.B.2.b.; Base Case assumptions and estimates, Section IV.A.1. and 2.).

Proposed Central Gulf Sale 131 is scheduled to be held in March 1991 and will offer approximately 5,204 unleased blocks (as of June 1990), comprising about 28.1 million acres in the Central Planning Area (CPA). This area includes acreage located from 4.8 to 354 kilometers (km) offshore in water depths ranging from 4 to 3,425 meters (m).

The alternatives are to delete biologically sensitive areas near topographic features or to take no action (cancel the sale). The potential mitigating measures proposed are protection of biological resources (topographic features and live bottoms), protection of archaeological resources, and mitigation of conflicts with military activities.

The following major assumptions and estimates are included in the analysis of the potential impacts of proposed Sale 131 (Base Case).

- The discovery and production of 0.13 billion bbl of oil (BBO) and 1.21 trillion cubic feet (tcf) of gas during the period 1993-2024.

- The drilling of 310 exploration and delineation wells during the period 1992-2002.

- The installation of 25 production platforms and the drilling of 230 development wells during the period 1993-2018.

- The construction of 201 km of offshore pipeline (gathering and mainline).

- The transport of about 3 percent of produced oil via barge and about 0.03 percent via shuttle tanker.

- No major onshore support or processing facility construction is expected to occur solely as a result of the proposed action.

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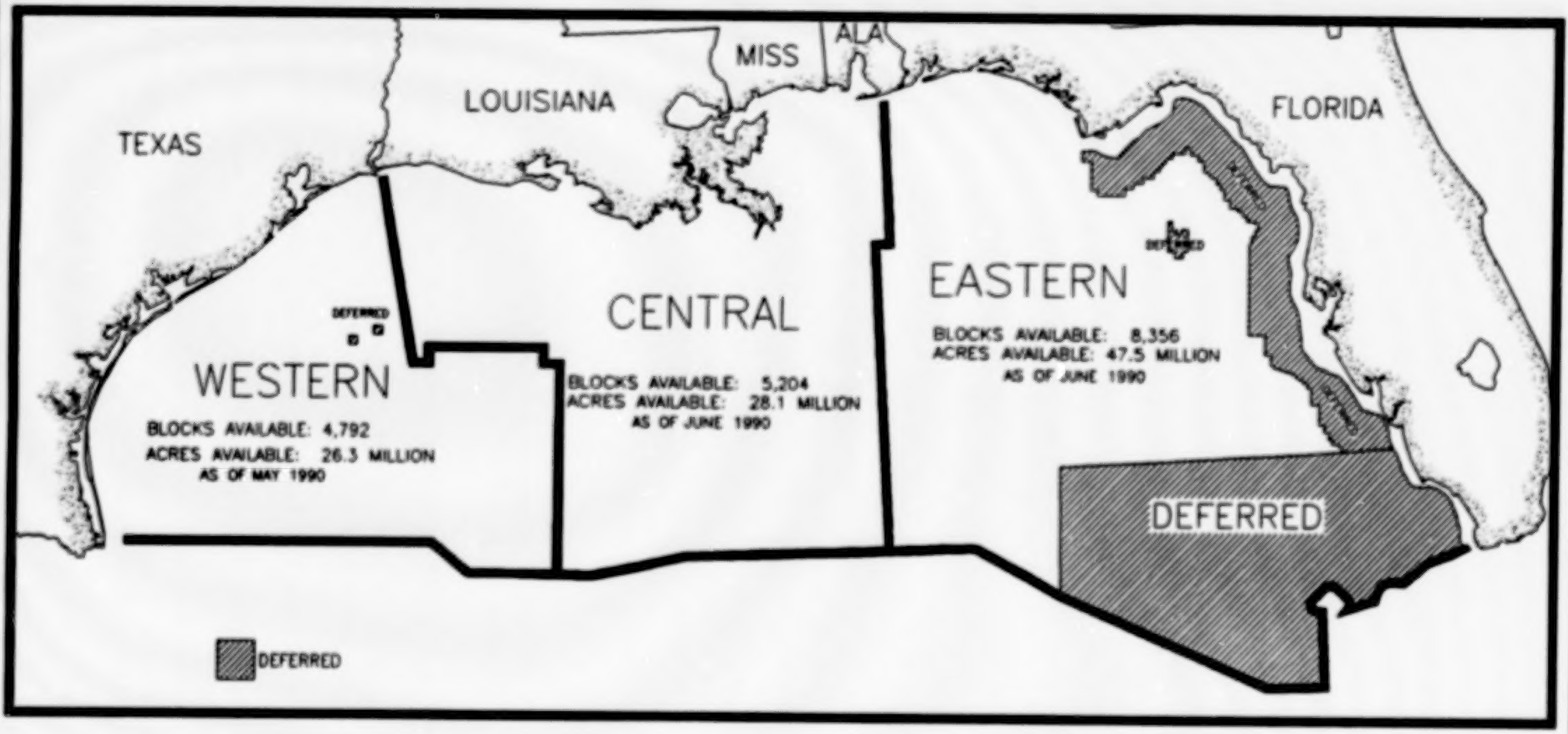

Figure I-1. Central Gulf Sale 131, Western Gulf Sale 135, and Eastern Gulf Sale 137 Planning Areas, Indicating the Number of Blocks and Acres Available Under Each Proposed Action.

Proposed Western Gulf Sale 135 is scheduled to be held in August 1991 and will offer approximately 4,792 unleased blocks (as of May 1990), comprising about 26.3 million acres in the Western Planning Area (WPA). This area is located from 14 to 357 km offshore in water depths ranging from 8 to over 3,000 m. Blocks A-375 (East Flower Garden Bank) and A-398 (West Flower Garden Bank) in High Island Area, East Addition, South Extension, were deferred (or excluded) from this proposed action because of the environmentally sensitive nature of the biological communities located in the blocks.

The alternatives are to delete biologically sensitive areas near topographic features or to take no action (cancel the sale). The potential mitigating measures proposed are protection of biological resources (topographic features and pinnacle trend live bottoms), protection of archaeological resources, and mitigation of conflicts with military activities.

The following major assumptions and estimates are included in the analysis of the potential impacts of proposed Sale 135 (Base Case).

- The discovery and production of 0.05 BBO and 0.72 tcf of gas during the period 1993-2024.
- The drilling of 200 exploration and delineation wells during the period 1992-2002.
- The installation of 15 production platforms and the drilling of 110 development wells during the period 1993-2014.
- The construction of 121 km of offshore pipeline (gathering and mainline).
- The transport of about 18.2 percent of the produced oil via shuttle tanker and about 3 percent via barge.
- No major onshore support or processing facility construction is expected to occur solely as a result of the proposed action.

Proposed Eastern Gulf Sale 137 is scheduled to be held in November 1991 and will offer approximately 8,356 unleased blocks (as of June 1990), comprising about 47.5 million acres in the Eastern Planning Area (EPA). This area is located from 16 to 483 km offshore in water depths ranging from 10 to over 3,400 m. Excluded from this proposed action are the areas approximately 32 to 48 km seaward of the western coastline of Florida, extending from the Apalachicola/Cape San Blas area on the north to latitude 26°N to the south, as well as 23 blocks centered around the Florida Middle Ground (both deferred at the time of the 5-Year Program Decision), and the region south of latitude 26°N to the State waters north of the Keys and west to approximately longitude 86°W. There are also five alternatives to the proposed action and five potential mitigating measures available for adoption under proposed Sale 137.

The alternatives are to delete the Inner Cape San Blas blocks, delete the U.S. Navy's carrier operation area, delete the U.S. Air Force's drone runway area, delay the sale, and take no action (cancel the sale). The potential mitigating measures are protection of biological resources (live bottoms), protection of archaeological resources, mitigation of conflicts with military activities, and two separate sets of requirements for certain oil spill response capabilities in two areas off the Florida panhandle.

The following major assumptions and estimates are included in the analysis of the potential impacts of proposed Sale 137 (Base Case).

- The discovery and production of 0.04 BBO and 0.06 tcf of gas during the period 1998-2029.
- The drilling of 90 exploration and delineation wells during the period 1995-2002.
- The installation of 10 production platforms and the drilling of 50 development wells during the period 1998-2020.

- The construction of 80 km of offshore pipelines.

- The transport of about 82.6 percent of produced oil via shuttle tanker.

- No major onshore support, processing, or transportation facility construction is expected to occur solely as a result of the proposed action.

In addition to the alternatives and protective mitigating measures that are options for each proposed lease sale, there are a number of statutory requirements, regulations, and procedures in place that are designed to avoid environmental/safety-related problems. These requirements, regulations, and procedures have evolved over the 35+ years of leasing for oil and gas on the OCS. The following are examples of some of the most important of these measures.

Plans of Exploration (POE) and Plans of Development and Production (POD) must be submitted and approved by MMS before an operator can begin exploratory drilling on any OCS lease or development and production activities on an Eastern Gulf OCS lease (activities elsewhere in the Gulf require a Development Operations Coordination Document (DOCD) as described later). Both types of plans must include supporting information providing an analysis of onshore and offshore impacts that may occur as a result of implementation of the plan. Based on this and other available information, MMS prepares either a Categorical Exclusion Review (CER), an Environmental Assessment (EA), or an EIS. Plans must also include a certification of consistency with the approved Coastal Zone Management (CZM) program of the affected State (the only Gulf Coast state that does not have such a program is Texas). The certification assures that the activities described in the plan will be conducted in a manner consistent with the program. More information on the requirements of these plans is available in Sections I.B.3.b.(1)(a) and (b).

Oil-Spill Contingency Plans (OSCP) must be submitted by an operator for approval with, or prior to, a Plan of Exploration or Plan of Development/Production. This contingency plan, outlining the availability of spill containment and cleanup equipment and trained personnel, is reviewed and updated annually. The OSCP must assure that full response capability could be committed during an oil-spill emergency. This commitment would include specification for appropriate equipment and materials, their availability, and the time needed for deployment. The OSCP also must include provisions for varying degrees of response effort, depending on the severity of the spill. See Sections I.B.3.b.(1)(c) and IV.C.6. for more information.

Inspections are conducted by MMS, in accordance with the OCSLA, before, during, and after operations to assure that safety and pollution-prevention requirements are met. Inspections are to include all safety equipment designed to prevent or ameliorate blowouts, fires, spillage, or other major accidents. Inspections assure that the best available and safest technology (BAST) is used for operations and procedures that, if failed, could have a significant effect on safety, health, or the environment. See Sections I.B.3.b.(2)(a) and I.B.3.b.(3)(a)(2) for more information on inspections and BAST.

Training of oil-field personnel is another important factor in ensuring that OCS operations are carried out in a manner that emphasizes safety and minimizes the risk of environmental damage. Everyone directly concerned with the actual drilling of a well is required to have passed a course in well control at an MMS approved school. In addition, all operators must have trained personnel to operate oil-spill cleanup equipment or must have retained a trained contractor to operate the equipment for them. For more information see Section I.B.3.b.(3)(c)(3).

Details on additional regulations and procedures that are important environmental/safety measures are provided below in Section I.B.3.

B. BACKGROUND

1. Administrative Events Leading to the Proposed Actions

The process leading to the proposed sales began when the Call for Information and Nominations (Call) and the Notice of Intent to Prepare an EIS (NOI) for the 1991 lease sales were published in the *Federal Register* on May 2, 1989. Copies of the Call/NOI were also mailed to individuals; environmental groups; Federal, State, and local government agencies; and industry to ensure that those with an interest in the OCS program would have an opportunity to participate in the process. Additional requests for specific environmental/resource information were sent to Federal, State, and local agencies and to individuals on May 10 and May 12, 1989, respectively.

2. Scoping Activities and Findings

Scoping is the process by which issues related to the proposed actions are identified. A scoping effort was conducted for this EIS to provide further information for the development of appropriate alternatives and mitigating measures, as well as to identify significant issues. The governors of the Gulf States; Federal, State, and local agencies; industry; environmental groups; and interested individuals were given an opportunity to comment. Section V contains a detailed description of this consultation and coordination process. The result of the scoping effort was the selection of the alternatives, mitigating measures, and issues described below.

a. Alternatives

(1) Alternatives for Proposed Central Gulf Sale 131

Alternative A (The Proposed Action): The proposed action is an offer to lease all unleased areas within the CPA for oil and gas exploration and development. It is estimated that the proposal could result in the production of 0.13 BBO and 1.21 tcf of gas after leases are issued and exploration occurs.

Alternative B (Delete Biologically Sensitive Offshore Habitats): This alternative would delete all unleased blocks of the 167 total blocks on or near biologically sensitive areas of the topographic features in the Central Gulf.

Alternative C (No Action): This alternative equates to cancellation of the sale. Potential impacts and oil and gas production that could result from the proposed action would not occur. Other potential alternative energy resources that might be used to replace this lost-resource production have been discussed in Appendix F.

(2) Alternatives for Proposed Western Gulf Sale 135

Alternative A (The Proposed Action): The proposed action is an offer to lease all unleased areas within the WPA for oil and gas exploration and development, with the exception of the following blocks excluded from the Call: Block A-375 (East Flower Garden Bank) and Block A-398 (West Flower Garden Bank) in High Island Area, East Addition, South Extension. It is estimated that the proposal could result in the production of 0.05 BBO and 0.72 tcf of gas.

Alternative B (Delete Biologically Sensitive Offshore Habitats): This alternative would delete all unleased blocks of the 200 total blocks on or near biologically sensitive areas of the topographic features in the Western Gulf.

Alternative C (No Action): This alternative equates to cancellation of the sale. Potential impacts and oil and gas production that could result from the proposed action would not occur. Other potential alternative energy resources that might be used to replace this lost-resource production have been discussed in Appendix F.

(3) Alternatives for Proposed Eastern Gulf Sale 137

Alternative A (The Proposed Action): The proposed action is an offer to lease all unleased areas within the EPA for oil and gas exploration and development, with the exception of the following areas excluded from the Call: a strip approximately 32 to 48 km seaward of the western coastline of Florida, extending from the Apalachicola/Cape San Blas area on the north to latitude 26°N to the south, as well as 23 blocks centered around the Florida Middle Ground (both deferred at the time of the 5-Year Program Decision), and the region south of latitude 26°N to the State waters north of the Keys and west to approximately longitude 86°W. It is estimated that the proposal could result in the production of 0.04 BBO and 0.06 tcf of gas.

Alternative B (Delete Inner Cape San Blas Blocks): This alternative would remove from consideration for leasing the area within the EPA known as the Inner Cape San Blas Blocks. This area includes 47 blocks, or approximately 547,400 acres, adjacent to the State/Federal boundary from Cape San Blas east to Panama City, Florida. This alternative would provide a buffer zone between potential oil and gas activities and the adjacent coastal area, as requested by the State of Florida.

Alternative C (Delete Naval Operations Area): This alternative would remove from consideration for leasing 244 blocks, or approximately 1.4 million acres, in the U.S. Navy's Carrier Operations Area in the northwestern portion of the EPA. This alternative would preclude potential multiple-use conflicts between OCS activities and Naval operations.

Alternative D (Delete Drone Operations Area): This alternative would remove from consideration for leasing 60 whole or split blocks, or approximately 305,000 acres, in the area where the U.S. Air Force uses drone aircraft for military training exercises. This area is located in the northeastern portion of the EPA, in the nearshore waters off Panama City. This alternative would preclude potential multiple-use conflicts between OCS activities and drone operations.

Alternative E (Delete the Panhandle Buffer Zone): This alternative would delete 642 blocks, or approximately 3.5 million acres, in an area some 50 km (30 mi) seaward of the Federal/State boundary off Gulf County, Florida, and extending westward to the boundary of the EPA and CPA off Baldwin County, Alabama (Figure II-9). This alternative would provide a buffer zone between potential oil and gas activity resulting from the proposed sale and the adjacent coastal areas.

Alternative F (Delay the Sale): This alternative would delay the sale of unleased blocks in the EPA for an unspecified time period. The basic assumption is that all impacts associated with the proposed action would be delayed for approximately one year.

Alternative G (No Action): This alternative is equivalent to cancellation of a sale scheduled for a specific timeframe on the approved 5-Year OCS Oil and Gas Leasing Schedule. Therefore, the opportunity is foregone or postponed for development of the estimated oil and gas resources that could have resulted from the proposed action. Also, any potential environmental impacts resulting from the proposed action would not occur. Other potential alternative energy resources that might be used to replace this lost resource production have been discussed in Appendix F.

(4) Alternatives Considered But Not Offered

Delete Outer Cape San Blas Blocks: This alternative would remove 64 blocks located seaward of the 46 blocks that are included in the Inner Cape San Blas Blocks Deletion Alternative, as described above. This alternative is not included in this EIS in accordance with an agreement dated March 24, 1988, between the Governor of the State of Florida and the Secretary of the Interior. The agreement stated, in part, that the blocks would remain available for the proposed Sale 137 subject to completion of an oil-spill containment/cleanup plan. Such a plan is being offered as a potential stipulation for leases in this area.

Substitute Alternative Forms of Energy for the Proposed Action: The substitution of alternative energy (solar, wind power, etc.) was recommended as an alternative to the proposed actions. Alternative C (No Action) for both the CPA and the WPA and Alternative G for the EPA equate to cancellation of the sale. If these alternatives were selected, development of any oil and gas resources that might have resulted from the proposed action would not occur. Therefore, oil and gas not produced would be replaced, at least in part, by energy from other sources, as discussed in Appendix F.

b. Mitigating Measures

(1) Potential Mitigating Measures

The mitigating measures included for analyses in this EIS were developed as the result of the scoping efforts accomplished early in the process for the EIS and over recent years for the continuing OCS program.

Four standard stipulations have been applied to appropriate Gulf OCS leases for many years with considerable success. These four standard stipulations and more recently developed stipulations on oil spill response in the panhandle region of Florida are proposed as mitigating measures for proposed Sales 131/135/137. The potential stipulations are the live bottom (Pinnacle Trend), topographic features, archaeological resources, and military areas stipulations for the proposed Central Gulf sale; the topographic features, archaeological resources, and military areas stipulations for the proposed Western Gulf sale; and the live bottom, archaeological resources, oil spill response, and military areas stipulations for the Eastern Gulf sale. The stipulations and the discussions of their effects are located in Sections II.A.1.c., II.B.1.c., and II.C.1.c. of this document.

Live-bottom Stipulation

Two areas within the Central and Eastern Gulf are considered for protection with the implementation of the Live-bottom Stipulation.

The proposed Live-bottom Stipulation for Sale 131 covers the pinnacle trend area of the CPA. The northeastern portion of the Central Gulf contains a band of pinnacles between 67 and 109 m (220-360 ft) in depth, which extends into the northwestern portion of the Eastern Gulf. The pinnacles appear to be dead reefal structures with limited biotal coverage, but they may provide structural habitat for a variety of pelagic fish. A Live-bottom Stipulation has been made a part of previously issued leases and is a part of many active leases in the Central Gulf. This stipulation has been deemed necessary in the past since the position and extent of many of the sensitive and high-value, live-bottom areas were poorly known. These areas are, for the most part, patchy and scattered.

The Live-bottom Stipulation for the Eastern Gulf covers all blocks to depths of 100 m. The offshore areas of the Eastern Gulf are scattered with live-bottom communities comprised of sponges, octocorals, gorgonians, and a few hard corals. The actual extent and location of these live bottoms is unknown. This stipulation is proposed because of the scattered nature of these areas, the sensitivity and value of live bottoms, and the potential for impact to the live bottoms from leasing activities.

Topographic-features Stipulation

The topographic features of the Central and Western Gulf provide habitat for coral and coral-community organisms. These communities would be severely and adversely impacted by unrestricted oil and gas activities resulting from the proposed actions if such activities took place on, or in proximity to, them. The Department has recognized this problem for some years and, since 1973, stipulations have been made a part of leases for blocks on or near enough to these biotic communities for the nearby oil and gas activities to have an impact on them. The topographic-features stipulation--which developed through close consultation and coordination between various State, Federal, and local agencies--uses the results of the latest topographic-features studies and industry monitoring reports.

Archaeological Stipulation

This stipulation was first implemented in 1973 in response to the requirements of the National Historic Preservation Act of 1966, as amended. This Act states, in effect, that prior to approving Federally permitted or funded undertakings, all Federal agencies must consider the effect of the proposed undertaking on any National Register or National Register eligible property. Implied in this legislation and Executive Order 11593 is that an effort be made to locate such sites before an area is developed. The OCSLA, as amended, specifically states in Section 11 (g)(3) that "such exploration (oil and gas) will not disturb any site, structure, or object of historical or archaeological significance."

The stipulation includes a clause that requires an archaeological assessment of geophysical survey data within areas where the Regional Director has a reason to believe that an archaeological resource is likely to exist. Archaeological management zones derived from the findings of the Gulf of Mexico cultural resources baseline study (CEI, 1977) are used as the basis for invoking the archaeological survey requirement. All tracts leased within Archaeological Zone 1, where there is a high potential for the occurrence of historic sites, require a survey of 150-m linespacing. Tracts leased within Zone 2, where there is only the potential for the occurrence of prehistoric sites, require a survey of 300-m linespacing. The requirements for the archaeological survey and report are detailed in Notice to Lessees (NTL) 75-3, Revision No. 1.

The archaeological stipulation has reduced the potential impacts to archaeological sites from oil and gas development by allowing detection of potential sites prior to development, thereby making avoidance possible.

Military-areas Stipulations

A standard Military-areas Stipulation has been applied to all blocks leased in military areas in the Gulf of Mexico since 1977. One of the requirements of the stipulation is that the operator will notify the military prior to conducting oil and gas activities in an area. The effectiveness of the stipulation may be illustrated by the fact that there have been no reported accidents in the Gulf resulting from conflicts between oil and gas operations and military activities.

Blocks leased in particular areas of the Eastern Gulf have an additional clause, which addresses evacuation during military testing, attached to the standard stipulation. Certain areas in the EPA are also subject to a second military stipulation that concerns restrictions on the location and timing of exploration activities within the area.

Oil-spill Response Stipulations

There are two Oil-spill Response Stipulations offered as potential mitigating measures in the Eastern Gulf. These stipulations are intended to minimize the risk of oil spills reaching Florida State waters by requiring the staging of state-of-the-art mechanical oil-spill-response equipment within specified timeframes and by requiring that oil dispersant chemicals and equipment be maintained in a state of readiness. The first stipulation applies to 168 blocks, referred to as the Panhandle blocks, located in a 32-km zone adjacent to the State/Federal boundary between the Florida-Alabama State line and Panama City, Florida. These 168 blocks are made up of two areas as depicted on Figure II-3. The shoreward area is more subject to more stringent requirements under the stipulation than the area farther from shore. The second stipulation applies to two areas known as the Inner and Outer Cape San Blas Blocks (47 and 64 blocks, respectively) as depicted on Figure II-4. The stipulation is identical for both of the areas, but the areas are identified separately because the inner area is offered as a deletion alternative, as described above.

(2) Mitigating Measures Considered But Not Offered

Measures considered but not included for analyses are described below, along with reasons for not offering them as potential mitigation.

Regulation of Solid-Waste Disposal Offshore

The State of Texas recently urged, in response to earlier scoping efforts, that MMS institute regulations for oil and gas leases that would prohibit the disposal of any refuse from vessels or structures in Federal waters. Such a mitigating measure is not proposed in this EIS because under existing MMS, USEPA, and Coast Guard regulations, deliberate disposal of any solid waste or garbage items anywhere in the marine environment is strictly prohibited. Because of increased concern with the prevalence and effects of persistent marine debris both offshore and on coastal beaches, MMS issued a special advisory (NTL 86-11) in 1986 strongly encouraging industry to take special educational, operational, and awareness measures designed to reduce or eliminate the oil and gas industry's contributions to marine debris in the Gulf of Mexico.

Mitigating Measures for Resources Experiencing High Cumulative Impacts

The State of Louisiana recently expressed concern that while the cumulative and long-term impacts to some resources have been ranked as high or very high by MMS, no specific mitigation alternatives have been proposed for their amelioration. Cumulative impacts are those resulting from OCS activities in combination with all other impact-producing factors from any program or activity that might have an effect on the resource in question. The MMS, through its environmental studies program and in-house analyses, continues to develop an understanding of the contribution of OCS activities to the degradation of the resources of the Gulf and to recommend potential mitigating measures where appropriate.

c. Issues

(1) Significant Issues

The topics considered for analysis in the EIS are significant issues that meet some or all of the criteria listed below and are, therefore, fully analyzed.

SELECTION CRITERIA

- The resource/activity was identified through scoping or through comments on a draft EIS.
- The resource/activity must be vulnerable to one or more of the impact-producing factors (IPF's) associated with the OCS program. To be vulnerable, the location and temporal aspects of the resource/activity must be such that an interaction with an IPF could occur. A reasonable probability of an interaction between the resource/activity and IPF should exist.
- New information that indicates a need to reevaluate the potential impacts to a resource/activity has become available.

Resource	Impact-producing Factors	Location in the EIS
Sensitive Coastal Habitats a. Coastal Barriers b. Wetlands c. Seagrasses	Oil spills, construction of navigation channels and canals, emplacement of pipelines, construction of onshore facilities, maintenance dredging, and vessel traffic.	Sections IV.D.1.a.(1), IV.D.2.a.(1), and IV.D.3.a.(1)
Sensitive Offshore Habitats and Communities a. Live-bottom Areas b. Deep-water Benthic Communities c. Topographic Features	Mechanical damage due to anchors, emplacement of drilling and support structures, and drilling operations and laying of pipelines; damage to the biota by smothering or by toxicity of drilling fluids, cuttings, produced water, oil spills, and resuspension of sediments due to a blowout.	Sections IV.D.1.a.(2), IV.D.2.a.(2), and IV.D.3.a.(2)
Water Quality a. Coastal and Nearshore b. Offshore	Discharges related to catastrophic events and onshore and offshore operations.	Sections IV.D.1.a.(3), IV.D.2.a.(3), and IV.D.3.a.(3)
Air Quality	Emissions from catastrophic events and onshore and offshore operations.	Sections IV.D.1.a.(4), IV.D.2.a.(4), and IV.D.3.a.(4)
Endangered and Threatened Species	Oil spills, offshore structure removals, geophysical exploration, increased vessel and traffic, onshore facilities construction, and trash and debris.	Sections IV.D.1.a.(5), IV.D.2.a.(5), and IV.D.3.a.(5)
Marine Mammals	Oil spills, offshore structure removals, geophysical exploration, increased support vessel and air traffic, onshore facility construction, and trash and debris.	Sections IV.D.1.a.(6), IV.D.2.a.(6), and IV.D.3.a.(6)

Coastal and Marine Birds	Oil spills, vessel and air traffic, pipeline landfalls, onshore facilities construction, and trash and debris.	Sections IV.D.1.a.(7), IV.D.2.a.(7), and IV.D.3.a.(7)
Commercial Fishing Industry	Oil spills, gear conflicts, and structure emplacement.	Sections IV.D.1.a.(8), IV.D.2.a.(8), and IV.D.3.a.(8)
Recreational Activities and Associated Tourism a. Beach Use b. Recreational Fishing	Trash and debris, oil spills, tar balls, pipeline landfalls, and onshore facilities construction. The potential for recreational fishing impacts exists through space-use conflicts or catastrophic spills.	Sections IV.D.1.a.(9), IV.D.2.a.(9), and IV.D.3.a.(9)
Archaeological Resources a. Historic b. Prehistoric	Emplacement of offshore and onshore infrastructure, oil spills, and oil-spill-cleanup activities.	Sections IV.D.1.a.(10), IV.D.2.a.(10), and IV.D.3.a.(10)

(2) Topics Not Analyzed

It has been determined through scoping that the following topics are not of sufficient significance to require indepth analysis in the EIS.

Estuarine Habitats

"Estuarine habitats" as a separate topic was raised as an issue to be analyzed. An estuary is defined as a "semi-enclosed coastal body of water which has a free connection with the open sea and within which seawater is measureably diluted with fresh water derived from land drainage" (Zottoli, 1978). Because of this broad definition, a number of habitat types are classified as "estuarine habitats". Estuaries can be classified by their population of organisms, energy flows, salinity or other chemical characteristic pathways, or their physical characteristics. There are a number of unique estuary systems along the Gulf Coast that are generally identified by their physical characteristics. These include sedimentary deltas, such as the Mississippi Deltaic Plain region, river mouths, tropical marine meadows comprised of underwater grassy vegetation, and bays and sounds. Within these settings, a number of habitats can be found. For example, the Mississippi Delta can be divided into 20 habitats that include agriculture, beach and dune, bottomland hardwood, brackish marsh, canal, cypress-tupelo, fresh aquatic bed, fresh marsh, fresh open water, fresh scrub-shrub, mangroves, flats, nearshore gulf, rivers and bayous, estuarine aquatic bed, estuarine open water, salt marsh, spoil, upland forest, and urban-industrial (Bahr et al., 1983). These estuarine habitats are comprised of major groups of organisms that include benthic algae, phytoplankton, zooplankton, nekton, macro- and meiobenthic organisms, microbial forms, plant communities that include submerged aquatic, floating, and floating-leaved vegetation, emergent vegetation, and upland plant communities, birds, insects, reptiles, and furbearing animals.

The CEQ guidance on the scoping of topics to be analyzed directs MMS to identify single, specific subjects to be analyzed through the scoping process, i.e., to narrow the scope of issues deserving study to avoid encyclopedic documents (40 CFR 1500.4). Through scoping, the many components of estuarine habitats were examined and we narrowed our analysis to only include those components determined significant.

Components of estuarine habitats analyzed in this EIS include coastal barriers, wetlands, coastal and nearshore water quality, whooping cranes, Eskimo curlews, Gulf sturgeon, piping plovers, brown pelicans, coastal birds, and commercial fish species located within the estuarine systems.

Threatened and Endangered Species (south of latitude 26°N)

The plant and animal species afforded special consideration by the Endangered Species Act and occurring only in the Eastern Gulf of Mexico south of latitude 26°N are not discussed in this EIS. These species include, but are not limited to, the following:

- Key deer
- Key Largo wood rat
- Stock Island tree snail
- Roseate tern
- Reindeer lichen
- American Crocodile
- Key Largo cotton mouth
- Lower Keys rabbit
- Florida panther
- Everglades kite
- Cape Sable sparrow
- Schaus sharptail butterfly
- Key tree cactus
- Garper's spurge

These species are not analyzed because they are unlikely to be adversely impacted by the Base and High Case scenarios of the proposed action. Neither scenario includes any onshore construction or use of port facilities in Collier or Monroe Counties; therefore, no terrestrial- or marine-transportation-related impacts are anticipated. Roseate terns nest on a spoil island during late spring and early summer just north of Key West (Runde, written comm., 1989), and feed in nearby coastal areas to the east and south of the Keys. They could be adversely affected if they encountered and fed within an area of spilled oil. The MMS oil-spill model indicates that there is less than a 0.5 percent probability of a large spill occurring and contacting Collier or Monroe Counties within 30 days. Protected species and their habitats are unlikely to come into contact with an oil spill resulting from the proposed action. Trash and debris generated by proposed Sale 137 are also unlikely to contact the species in question because of the small number of platforms generating debris, their distance from the protected species, and the undocumented association of the most common types of trash and offshore activities.

Local Economic Conditions

Concern exists over the possibility that OCS-generated employment in adjacent coastal communities may adversely affect local economies. In particular, the State of Louisiana commented on Draft EIS 123/125 and expressed concern over the possible "boom/bust" economic impact from areawide sales.

The proposed action may generate direct, secondary, and induced employment. Direct employment includes jobs associated with the oil- and gas-extraction industry, secondary employment includes jobs associated with oil- and gas-related industries, and induced employment includes jobs supported by expenditures of direct and secondary employees. The MMS analysis for the 5-Year OCS Oil and Gas Leasing Program indicates that job opportunities created by sales proposed for the 1988-1992 time period will allow a continuation of some existing oil/gas-related jobs in the CPA and WPA rather than attract new residents into the region. Therefore, the 1991 lease sales, which are a part of that 5-year lease-sale schedule, are not expected to result in any adverse impacts on local economic conditions. Instead, the continuation of some existing employment and income is considered beneficial and economically essential.

Tourism has been identified as a potential area of concern for the Eastern Gulf. An analysis of the potential impacts of the oil and gas industry on tourism in this region has been included in Sections II, III, and IV descriptions and in the analyses of impacts on recreational activities.

Seagrasses (Central and Western Gulf)

Impacts on coastal seagrass beds occurring in the CPA and WPA have not been raised as an issue during MMS scoping activities, and seagrass beds are known to occur on the OCS only on the West coast of Florida. With the exception of Florida seagrasses, previous analyses addressed seagrasses within the context of the wetland analysis and determined negligible interaction. Seagrasses occur infrequently in the CPA as scattered, discontinuous beds in open-water areas embedded in wetland areas. Seagrass beds in Texas are somewhat more frequent and are associated within the semiprotected lagoons located behind barrier islands. The vast majority of seagrasses are located in the EPA; a detailed discussion is provided in Section IV.D.3.a.(1)(c). The description of coastal seagrasses throughout the Gulf of Mexico is included in Section III.B.1.c. for general information. Previous analyses determined that any adverse effects on a wetland area or barrier islands by OCS oil spills or displacement operations would likewise impact embedded seagrasses. Based on the above, no separate analysis is presented in this EIS for seagrasses in the CPA or WPA.

Offshore Marine Recreational Fishing (Central and Western Gulf)

Recreational fishing activities have historically been found to have a beneficial impact from oil- and gas-related platforms located within areas accessible to offshore fishermen in the CPA and WPA. Extensive and definitive studies off Louisiana and Texas have shown that petroleum structures attract fish, fishermen, and scuba divers. They also significantly improve hook and line fishing. These impacts have been thoroughly documented and analyzed in previous EIS's including the Final EIS for Sales 104 and 105 (USDI, MMS, 1985a). The States of Louisiana and Texas are currently developing and implementing artificial reef programs designed to perpetuate the fisheries conservation and enhancement value of selected oil and gas structures (Rigs-to-Reefs). Comments and concerns regarding the continued viability on an extensive resident and tourist-marine recreational fishery off the West Coast of Florida warrants continued discussion and analyses of the effects of OCS exploration and development on recreational fishing in the EPA. This is discussed in Section IV.D.3.a.(9) of this EIS.

Ports

Many port facilities that border the Gulf of Mexico exist to serve the needs of ocean commerce. Some of these port facilities offer services associated with exploration, development, and production of OCS oil and gas activities. The impact of OCS activities on these facilities has been examined, and it has been determined that the demand for additional port and harbor space is very low. Unused capacity exists Gulfwide and is likely to continue to exist in the foreseeable future. Land for port and harbor use has been dedicated, cleared, and bulkheaded and is adequate for demand.

Port and service-base facilities that support offshore oil and gas activities are located in the Central and Western Gulf. Facilities in the Eastern Gulf that are suitable for personnel and food services exist, but they are largely unused. Scoping activities have included port visitations and data acquisition in all three planning areas of the Gulf with an emphasis on Florida facilities. The use and availability of port facilities has not been identified as an issue.

3. Regulatory and Administrative Framework

a. Presale Activity Information/Regulations/Coordination

(1) Federal/State Coordination

The National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4371 et seq.) requires that all Federal agencies shall utilize a systematic, interdisciplinary approach to protection of the human environment, which will ensure the integrated use of the natural and social sciences in any planning and decisionmaking that may have an impact upon the environment. The NEPA requires the preparation of a detailed EIS on any major Federal action that may have a significant impact on the environment, any adverse environmental effects that cannot be avoided or mitigated, alternatives to the proposed action, the relationship between short-term uses and long-term productivity of the environment, and any irreversible and irretrievable commitments of resources involved in the project.

In 1979, the Council on Environmental Quality published regulations that established uniform regulations for implementing the procedural provisions of the NEPA. These regulations (40 CFR 1500-1508, revised July 1, 1980) are aimed at accomplishing three principal goals: (a) to reduce paperwork and improve the quality of EIS's, to reduce delays, and to make the impact statement more useful to decisionmakers and the public; (b) to produce better decisions that further the national policy to protect and enhance the quality, of the human environment; and (c) to emphasize the need to focus on real environmental issues and alternatives. A procedure known as "scoping" was established to identify the scope and significance of important environmental issues associated with a proposed Federal action through coordination with Federal, State, and local agencies, the public, and any interested individual or organization prior to the development of an impact statement (40 CFR 1501.7). The process is also intended to identify and eliminate from further detailed study issues that are not significant or that have been covered by prior environmental review.

The DOI is responsible for performing certain regulatory and administrative functions during the presale stage. Prior to actual leasing, the OCSLA, as amended, requires the Department to coordinate with State and local governments when their States may be affected by oil and gas activities. Specific timeframes are developed during which the Secretary provides information to the States and they, in turn, have opportunities to comment and coordinate with the Secretary. Participation from the affected States and other interested parties is encouraged and sought at each step of the procedures that lead to lease issuance.

The Secretary is required to invite and consider suggestions from the Governor of any affected State during preparation of any proposed leasing program before it is published in the *Federal Register*. If any comment by a Governor of any affected State is received by the Secretary at least 15 days prior to submission of a leasing program to Congress and includes a request for any modification of a proposed program, the Secretary shall reply in writing, granting or denying a request in whole or in part. All correspondence between the Secretary and the Governor accompanies a proposed leasing program when it is submitted to Congress (43 U.S.C. 1344 (c)).

The MMS issues the Call for Information and Nominations and the Notice of Intent to Prepare an EIS (Call/NOI), which is published in the *Federal Register*, in order to gather information and nominations within a lease planning area from all interested parties. The basis for the Call/NOI is the approved 5-year leasing plan. It provides an opportunity for identifying and communicating interests and concerns to the Department for future decisions in the leasing process. Responses must be received no later than 45 days after publication of the Call/NOI.

The information collected from the Call is used to identify the areas of potential for oil and gas development, to identify issues/concerns of industry, to analyze the environmental effects and potential use conflicts in proximity of the area, to initiate the scoping process and alternatives to the proposed action for the EIS, to develop lease terms and conditions, to ensure safe operations, and to identify potential conflicts between offshore oil and gas activities and a State Coastal Management Program.

The NOI is published pursuant to the regulations at 40 CFR 1501.7, implementing the procedural provisions of the National Environmental Policy Act (NEPA) (42 U.S.C. 4321 et seq.). The NOI also serves to announce the scoping process, which affords State and local governments the opportunity to aid MMS in determining significant issues and alternatives to be analyzed in the EIS.

When soliciting information for the leasing of lands within 3 miles of the seaward boundary of any coastal State, additional information is provided to the Governors of those States. The Governors must be informed of the identity of, and schedule for, the area proposed for leasing; the geographic, geological, and ecological characteristics of the area within 3 miles of the seaward boundary; estimated oil and gas reserves in these areas; and any field, trap, or geologic structure thought to be located in these areas (43 U.S.C. 1337 (g)). The Secretary subsequently consults with the Governors in determining whether any areas may contain one or more oil or gas pools or fields underlying both the OCS and lands subject to State jurisdiction. The ultimate goal of the coordination is the fair and equitable disposition of accrued revenues and interest.

The Governors are also provided with a summary of data to aid them in anticipating possible onshore effects of OCS development and production. The summary includes estimates of oil and gas reserves in areas leased or to be leased, estimated size and timing of development, pipeline locations, and the general location and nature of onshore facilities. The OCSLA, as amended, also requires the transmittal of an index of all relevant actual or proposed programs, plans, reports, EIS's, and other lease-sale information to each affected State (43 U.S.C. 1352 (d)).

(2) Geological and Geophysical Exploration Regulations/Coordination

Geological and geophysical (G&G) surveys and analyses provide most of the resource and hazards information used by government and industry on the mineral potential of offshore areas. The collecting of

G&G data begins prior to the leasing of Federal land and continues throughout the term of offshore mineral leases.

Pursuant to 30 CFR 251.4, a permit or notice must be obtained in order to conduct either geological or geophysical exploration for mineral resources or geological or geophysical scientific research of areas of the Gulf OCS, except for a lessee on a lease. A permit is approved for a specified period of time of not more than 1 year under which a party has the right to conduct geological or geophysical exploration for mineral resources or geological or geophysical scientific research in accordance with the appropriate statutes, regulations, and stipulations. A notice is a statement of intent to conduct geological scientific research on the OCS for a specified period of not more than a year.

"Geological exploration for mineral resources" means any operation conducted on the OCS that uses geological and geochemical techniques, including, but not limited to, core and test drilling, well-logging techniques, and various bottom-sampling methods to produce information and data on mineral resources, including information and data in support of possible exploration and development activity. "Geophysical exploration for mineral resources" means any operation conducted on the OCS that uses geophysical techniques, including, but not limited to, gravity, magnetic, and various seismic methods to produce information and data in support of possible exploration and development activity. "Geological or geophysical scientific research" means any investigation conducted on the OCS that uses scientific methods and/or techniques to gather and analyze geological and/or geophysical data and information for scholarly or academic purposes with no direct commercial application.

Permit applications for G&G activity must be submitted to MMS in accordance with the requirements outlined in 30 CFR 251.5 and 30 CFR 251.6 and explained further in Letter(s) to Permittees. The Letter to Permittees dated January 20, 1989, includes a listing of current forms and maps that apply to most G&G permit activity. The regulations under 30 CFR 251 do not apply to G&G exploration activities conducted by, or on the behalf of, the lessee on a leased block on the Gulf OCS. Geological and geophysical activities by the lessee on his existing leases are governed by the regulations in 30 CFR 250.

Geological and geophysical activities carried out under a 30 CFR 251 OCS exploration permit are not activities affecting land or water uses in the coastal zone within the meaning of Section 307 (c)(3)(A) of the Coastal Zone Management Act (CZMA) of 1972, as amended. The Gulf Coast States are not involved in the review process for specific G&G applications prior to issuance of the permit, except for deep stratigraphic tests (DST's). The DST's involve penetration into the sea bottom on unleased lands that involve more than 15 m (50 ft) of consolidated rock or a total of 91 m (300 ft) of unconsolidated material. Shallow test drilling involves drilling into the sea bottom at depths less than those specified for DST's. Environmental reports are required in accordance with 30 CFR 251.6-2(6) for DST's; and when required under a coastal zone management program, they must receive State concurrence prior to approval of any activities covered under the permit. The plan and report is also made available to appropriate Federal agencies and the public in accordance with established practices and procedures. Shallow test drilling or DST's must use the best available and safest technologies that the MMS determines to be economically feasible. Additional environmental information may be required for G&G applications proposing the use of solid or liquid explosives. The use of explosives may also lead to initiation by MMS of consultation with NMFS under Section 7 of the Endangered Species Act.

After receiving a G&G permit application, MMS prepares either a CER, EA, or EIS in accordance with NEPA and other applicable MMS policies and guidelines as described in Section I.B.3.b.(1)(a). A CER is prepared for most G&G permit applications. Activities that include the drilling of DST holes involve the use of solid or liquid explosives, or activities that otherwise have the potential to significantly affect the quality of the human environment automatically require the preparation of an EA.

b. Postsale Activity Regulations/Coordination

The MMS is responsible for regulating and monitoring the oil and gas operations on the Federal OCS. The regulations at 30 CFR 250.5(a) provide for the Director to regulate all operations conducted under a lease, right of use and easement, or DOI pipeline right-of-way to promote orderly exploration, development, and production of mineral resources and to prevent unreasonable harm or damage to, or waste of, any natural resource, any life or property; or the marine, coastal, or human environment. On April 1, 1988, the *Federal Register* (53 CFR 10596-10777) published the final rules that restructured and consolidated the rules governing oil, gas, and sulphur exploration, development, and production operations. These rules were effective on May 31, 1988. Prior to either exploration, development, or production activities being conducted in a lease block, other than on-lease preliminary activities, companies must submit plans to MMS for review and approval. Within these plans, specific requirements must be met relative to operating conditions and environmental considerations. The regulations now allow for penetration of the seabed up to 152 m (500 ft) for on-lease preliminary activities, provided such activities do not result in any significant adverse impact on the natural resources of the OCS (30 CFR 250.31). Prior notification or approval may be required by MMS.

(1) Review, Coordination, and Approval of Exploration, Development, and Production Activities

(a) Exploration Plans

Pursuant to OCSLA (43 U.S.C. 1340) and 30 CFR 250.33, an exploration plan and its supporting information must be submitted for approval to MMS before an operator may begin exploratory drilling on a lease. The plan describes all exploration activities planned by the operator for a specific lease(s), the timing of these activities, information concerning drilling vessels, the location of each well, and other relevant information. A revised plan is a revision to an approved plan that proposes changes such as those in surface location, type of drilling unit, or location of the onshore support base. A supplemental plan constitutes a revision to an approved plan that proposes the addition of an activity that requires a permit. An amended plan is any revision to a pending plan. Each of these types of plans need contain only that information related to or affected by the proposed revision.

The revised rule provides for submission of supporting information for MMS and CZM State evaluation as outlined in 30 CFR 250.33(b)(1) through (21). The operator may limit the amount of information submitted to that which is listed in the Letter to Lessees (LTL) dated October 12, 1988. Environmental reports are not considered a part of the plan. This was intended to eliminate unnecessary duplication. Lessees may, however, continue to submit the necessary information in more than one volume as part of the plan. The MMS can require modification of a plan based on inadequate or inaccurate supporting information, *inter alia*.

The supporting information provides an analysis of both offshore and onshore impacts that may occur as a result of implementation of the plan. In accordance with the CZMA, as amended, exploration plans requiring State review must contain a certification of consistency with approved CZM programs of States that could be affected by the exploration activities. States with approved programs may take up to 6 months for consistency reviews but must agree with or request an extension within 3 months after receipt of their copy of the plan. In the Gulf of Mexico, Louisiana, Mississippi, Alabama, and Florida have federally approved CZM programs. The guidelines and environmental information requirements for lessees and operators submitting an exploration plan are discussed further in Section I.B.3.b.(1)(e).

The MMS prepares a CER, EA, or EIS based on available information, which may include the geophysical report (for determining the potential for the presence of deep-water benthic communities), archaeological report (30 CFR 250.33(b)(15)), air emissions data, live-bottom survey/report (30 CFR 250.33(b)(12)), biological monitoring plan (30 CFR 250.33(b)(16)), and recommendations by the affected State(s), the Department of Defense, (DOD), Fish and Wildlife Service (FWS), (for selected plans under provisions of Departmental Manual (DM) 655, National Marine Fisheries Service (NMFS), and/or internal MMS offices. The MMS evaluates the proposed activity for potential impacts relative to geohazards and manmade hazards (including existing pipelines), archaeological resources, endangered species, sensitive biological features, water and air quality, and other uses (e.g., military operations) of the OCS.

The CER's are prepared for certain postlease activities in the WPA, CPA, and western part of the EPA in accordance with 516 DM 2, Appendix 1 and 516 DM 6, Appendix 10. That western portion of the EPA is offshore the State of Alabama from the CPA/EPA common boundary eastward to the offshore extension of the Alabama/Florida common boundary for State waters at approximately longitude 87°31'W (consult Visual No. 1 for further details). The criteria used to determine which actions are to be excluded from the NEPA process follow: the action or group of actions would have no significant effect on the quality of the human environment and the action or group of actions would not involve unresolved conflicts concerning alternative uses of available resources. The CER's do serve as a vehicle for a considerable environmental analysis in cases where archaeological, air quality, and biological assessments are necessary in early planning.

If the CER determines that the proposed action is an exception to the categorical exclusions as listed in 516 DM 2, Appendix 2, then the preparation of an EA is required. An EA may also be prepared on any action at any time in order to assist in planning and decisionmaking (516 DM 3.2.B) or under extraordinary circumstances (516 DM 2.4). The EA's are routinely prepared for actions in the Eastern Gulf of Mexico (offshore Florida), for selected environmentally sensitive areas (e.g., for activities proposed within the 4-mile zone of the Flower Garden Banks lease blocks), and for proposed activities considered environmentally sensitive (e.g., new or unusual technology and pipeline rights-of-way to shore).

If the EA indicates that approval of the plan would constitute a major Federal action significantly affecting the human environment, that an existing EIS addressing the matter does not exist, or that an existing EIS is not current, an EIS must be prepared. On the basis of the EA, CER, or EIS findings and the plan completeness review, the exploration plan will be either approved or disapproved, or modification of the plan will be required of the operator. The EA will also identify appropriate mitigation of impacts of the proposal.

(b) Development and Production Plans

Pursuant to OCSLA (43 U.S.C. 1351) and 30 CFR 250.34, a development and production plan and its supporting information must be submitted for approval to MMS before an operator may begin development or production activities. Development and production plans are not required for leases in the Western Gulf pursuant to 30 CFR 250.34-(d)(1). (In this designation, the Western Gulf includes all areas of the Gulf of Mexico except those that are adjacent to the State of Florida as defined previously.) However, information covering these leases is required to ensure conformance with the OCSLA, other laws, applicable regulations, and lease provisions and to enable MMS to carry out its functions and responsibilities. Therefore, before any development and production activity is conducted on a lease in the Western Gulf, the operator must prepare and submit to MMS a Development Operations Coordination Document (DOCD) and, as required, supporting environmental information, archaeological report, biological report (monitoring and/or live-bottom survey), or other environmental data determined necessary. A DOCD shall be considered a development and production plan for the purpose of any references in any law, regulation, lease provision, agreement, or other document referring to the preparation or submission of a plan. The plan describes a schedule of development activities, platforms, or other facilities including environmental monitoring features and other relevant information. Refer to Section I.B.3.b.(1)(b) for a discussion of plan revisions. The revised rule provides for submission of supporting information for MMS and State CZM evaluation as outlined in 30 CFR 250.34(b) through (u). As with exploration plans, MMS can require modification of a plan based on inadequate or inaccurate supporting information, *inter alia*.

After receiving the Plan of Development/Production (POD) or DOCD, MMS prepares either a CER, EA, or EIS as discussed under Exploration Plans above (Section I.B.3.b.(1)(a)). As part of the review process, the Plan and supporting environmental information, as required, are sent to the affected State(s) having an approved CZM plan for consistency certification review and determination. The OCSLA (43 U.S.C. 1345(a)) provides for coordination and consultation with the affected State and local governments concerning a development plan. The guidelines and environmental information requirements for lessees and operators submitting a development and production plan are addressed in NTL 86-09 and are discussed further in Section I.B.3.b.(1)(b). On the basis of the CER, EA, or EIS findings and the plan completeness review, the development/production plan is either approved or disapproved, or modification of the plan is required of the operator.

After the approval of the plan, the operator submits for approval specific applications to MMS, such as those for pipelines and platforms, to conduct activities described in the plan. At least once in the EPA, the Director of MMS will determine that an EIS is required for development/production activities.

(c) Oil Spill Contingency Plans

A lessee is required pursuant to 30 CFR 250.33, 30 CFR 250.34, and 30 CFR 250.42 to submit an Oil Spill Contingency Plan (OSCP) to MMS for approval with or prior to submitting an Exploration Plan, DOCD, or POD. If an OSCP covering the area, such as a regional plan, has already been approved, it may be referred to in the plan. In order to facilitate this requirement in the Gulf of Mexico OCS Region, an operator may submit a regional plan covering all of their Gulf OCS operations. The approved regional OSCP is then referenced when Exploration Plans or DOCD's are submitted. Additionally, certain site-specific, oil-spill-response information is required to accompany a POE or DOCD when a regional OSCP is referenced. An operator may elect to include or the MMS may require inclusion of a site-specific OSCP in an Exploration Plan or DOCD when the approved regional OSCP does not provide adequate oil-spill protection. All regional and site-specific OSCP's are required to be reviewed and updated annually, and all modifications of an OSCP are submitted to MMS for approval. Guidelines outlined in the February 1, 1989, and September 5, 1989, LTL's were developed to aid Gulf OCS operators in the preparation of OSCP's. The OSCP must contain assurances that a full response capability exists for commitment in the event of an oil spill. Such a commitment includes specification of appropriate equipment and materials, their availability and deployment time, and provisions for varying degrees of response effort, depending on the severity of the spill. Refer to Section IV.C.6. for additional information on oil-spill planning.

(d) Hydrogen Sulfide Contingency Plans

Pursuant to 30 CFR 250.33, 30 CFR 250.34, and 30 CFR 250.67, the operator of a lease requests that MMS make a determination regarding the presence of hydrogen sulfide (H_2S) gas. The MMS classifies an area of proposed operations as (1) a zone known to contain H_2S, (2) a zone where the presence of H_2S is unknown, or (3) a zone where the absence of H_2S has been confirmed. An H_2S Contingency Plan must be submitted for approval prior to conducting operations on a lease when the H_2S classification meets the criteria of (1) or (2) and must include contingencies for simultaneous drilling, well-completion, well-workover, and production operations. Pursuant to the LTL dated September 5, 1989, each POE or DOCD must contain a request for a determination for one of the three classifications and a discussion of the basis for the recommendation. The lessee must take all necessary and practicable precautions to protect personnel from the toxic effects of H_2S and to mitigate the adverse effects of H_2S to property and the environment.

(e) Environmental Information

Pursuant to 30 CFR 250.33 and 250.34, specific environmental information, as discussed in Sections I, II, and IV of NTL 86-09 and prepared in accordance with guidelines in Sections II.A., II.B., or III of the enclosure to NTL 86-09, is required for leases in the Gulf of Mexico for CZM purposes. It should be noted that the term "environmental report" as used in NTL 86-09 is synonymous with the term "environmental information" required by the Letter to Lessees dated October 12, 1988. Under the CZMA, each State that has an approved CZM plan has the option to require information that is different than that specifically outlined in 30 CFR 250.33 and CFR 250.34 for inclusion in the plan. Refer to Section I.B.4.c. for a discussion of the Gulf Region's procedures for CZM consistency. The States of Louisiana, Mississippi, Alabama, and Florida have approved CZM programs. With the exception of Florida, operators submit abbreviated environmental information for CZM purposes. Requirements for both the abbreviated format required for the States of Alabama, Louisiana, and Mississippi and the long-form format required for activity determined to affect the State of Florida are given in the LTL dated October 12, 1988 (NTL 86-09 incorporated therein by reference). The operating regulations, effective May 31, 1988, recognize the possible significance of proposed modifications to approved plans and provide for CZM agency review of modifications.

Additional environmental information may also be required for plans/activities in the Western Gulf of Mexico for the following: (1) areas of high seismic risk or seismicity and relatively untested deep-water and remote areas; (2) areas proposed or established as a marine sanctuary and/or near the boundary of a proposed or established wildlife refuge or areas of high ecological sensitivity (e.g., Flower Garden Banks); (3) areas of potentially hazardous natural bottom conditions; or (4) the use of new or unusual technology, when the additional information is required to evaluate impacts. Environmental information requirements will be determined on a case-by-case basis for plans meeting any of the four categories, with the exception of plans submitted that propose activities within the restrictive zones of the Flower Garden Banks. The guidelines enclosure of NTL 86-09 outlines the information requirements for activities proposed within the 4-mile zone of the Flower Garden Banks. Specific information is required for structure-removal applications as outlined in LTL's dated August 19 and December 9, 1986. The submission of specific supporting information to aid in evaluating the environmental impacts of plans/activities may be required by MMS under 30 CFR 250.33-(b)(21) and 30 CFR 250.34-(b)(15) in areas of the Central and Western Gulf where either no environmental information is required or an abbreviated format is required for CZM purposes.

(f) Air Emissions Information

The OCSLA at 43 U.S.C. 1334(a)(8) requires the Secretary to promulgate and administer regulations to provide for compliance with the National Ambient Air Quality Standards (NAAQS) pursuant to the Clean Air Act (42 U.S.C. 7401 et seq.) to the extent that authorized activities significantly affect the air quality of any State. This is accomplished through 30 CFR 250.44, 250.45, and 250.46, administered by MMS as a postsale activity. It is the intent of these regulations to protect onshore ambient air quality and to ensure that no new violations of the NAAQS are caused by the OCS activity. The regulated pollutants are carbon monoxide, suspended particulates, sulphur dioxide, and nitrogen oxides. Emissions data concerning new or modified onshore facilities (directly associated with offshore activities) are required to enable each affected State to make a determination of the effects on its air quality.

Plans of exploration, plans of development and production (Eastern Gulf of Mexico), and DOCD's address activities that are determined by the Secretary as activities regulated under 30 CFR 250.44, 250.45, and 250.46. All new or supplemental exploration plans, development and production plans, and DOCD's submitted on or after June 2, 1980, must include air emissions information sufficient to make an air quality determination. The LTL dated October 12, 1988, outlines air emissions data that must be submitted by operators (Section I.B.3.b.(1)(a)).

(g) OCS Structures and Equipment

(1) Wells

Prior to conducting drilling operations, the operator is required, pursuant to 30 CFR 250.64, to submit and obtain approval for an Application for Permit to Drill (APD) (Form MMS-331C). The lessee is required to take precautions to keep exploratory well drilling under control at all times. The APD is filed by the lessee/operator along with or following submission of the Exploration Plan or DOCD and supporting information. The APD requires detailed information about the drilling program for evaluation with respect to operational safety and pollution-prevention measures. Approval of an APD requires an MMS-approved Exploration Plan or DOCD and receipt of CZM consistency or presumptive concurrence. The approved APD constitutes the drilling permit. The APD is reviewed for conformance with the requirements of 30 CFR 250.64 and other engineering considerations. In addition, other information--including project layout at a scale of 2,000 ft to the inch, design criteria for well control and casing, blowout preventors, and a mud program--is required. The lessee must use the best available and safest technology in order to enhance the evaluation of abnormal pressure conditions and to minimize the potential for uncontrolled well flow. Specific requirements for well workovers, completions, abandonments, and sundry notices are detailed in Subparts D-G of the revised regulations. Significant deviations from an approved plan require that an environmental analysis be done in accordance with the procedures outlined in Section I.B.3.b.(1)(a).

(2) Platforms

The lessee must design, fabricate, install, use, inspect, and maintain all platforms and structures on the OCS to assure their structural integrity for the safe conduct of operations at specific locations. Applications for platform approval are filed in accordance with 30 CFR 250.131. Design requirements are presented in detail at 30 CFR 250.134-250.139. The lessee evaluates characteristic environmental conditions associated with operational functions to be performed. Factors such as waves, wind, currents, tides, temperature, and the potential for marine growth are considered. In addition, pursuant to 30 CFR 250.132 and 250.133, a program to assure that offshore oil and gas structures are designed, fabricated, and installed using standardized procedures to prevent structural failures has been established by MMS for new platforms meeting the criteria at 30 CFR 250.130(c). The program facilitates review of these structures and utilizes third-party expertise and technical input in the verification process through the use of a Certified Verification Agent. An environmental analysis would be conducted for any proposal involving the use of new or unusual technology in accordance with the procedures outlined in Section I.B.3.b.(1)(a).

(3) Production Facilities

Production safety equipment used on the OCS must be designed, installed, used, maintained, and tested in a manner to assure the safety and protection of the human, marine, and coastal environments. All tubing installations open to hydrocarbon-bearing zones below the surface must be equipped with safety devices that will shut off the flow from the well in the event of an emergency, unless the well is incapable of flowing. All surface production facilities, including separators, treaters, compressors, headers, and flowlines, must be designed, installed, and maintained in a manner that provides for efficiency, safety of operations, and protection of the environment. Surface- and subsurface-controlled safety valves and locks must conform to the requirements of 30 CFR 250.126. Production facilities also have stringent requirements concerning electrical systems, flowlines, engines, and firefighting systems. The safety-system devices are tested by the lessee at specified intervals and must be in accordance with API RP 14 C, Appendix D, and other measures.

(4) Pipelines

The DOI's exclusive jurisdiction with respect to pipeline activities extends upstream from the outlet flange at each facility where produced hydrocarbons are first separated, dehydrated, or otherwise processed to each production well in the OCS. In addition, those pipelines necessary for the development of a lease are under DOI's exclusive jurisdiction.

The MMS pipeline permit applications are filed under Subpart J of 30 CFR 250. Detailed requirements for filing the applications are found at 30 CFR 250.157 and 30 CFR 250.160. Normally, each permit application will contain the pipeline location drawing, profile drawing, safety schematic drawing, and the pipe design data to scale. Information submitted as part of the shallow hazard survey report/analysis and/or archaeological report is used for MMS environmental evaluations. Provisions governing offshore pipelines under the revised rulemaking include expanded requirements governing design, installation, testing, safety equipment, abandonment, and reporting. In considering applications for pipeline permits, MMS approves the design and fabrication of the pipeline and prepares a CER, EA, or EIS in accordance with applicable policies and guidelines. The MMS prepares an EA or EIS on all pipeline rights-of-way that go ashore (516 DM 6, Appendix 10). The FWS reviews and provides comments on applications for pipelines that are near sensitive biological features or that cross into State waters. The operators are required to inspect their routes at time intervals and methods prescribed by the Regional Supervisor for any indication of pipeline leakage (30 CFR 250.155(a)). Pipelines in the Gulf of Mexico are inspected monthly for leakage. Pipelines may be abandoned in place if they do not constitute a hazard to navigation and commercial fishing or unduly interfere with other uses of the OCS. Procedures for pipeline abandonment and pipeline reporting requirements are outlined in detail at 30 CFR 250.156 and 250.158.

(h) Site Clearance

The lessee must verify site clearance after abandonment through one of the methods given at 30 CFR 250.114 and 250.143. Certification that an area is cleared of all obstructions must be submitted on Form MMS-331, Sundry Notice, for well abandonment and by means of a letter from the company performing the work for fixed structures.

The use of explosives to cut offshore oil/gas structure legs/pilings for removal could cause injury or death to protected marine mammals and endangered sea turtles. Lessees/operators must notify MMS 30 days before a structure removal and provide information including the following: complete identification of the structure; size of the structure (number and size of legs and pilings); removal technique to be employed (if explosives are to be used, the amount and type of explosive per charge); and number and size of well conductors to be removed and the removal technique (see LTL's dated August 19 and December 9, 1986). Structure-removal request is reviewed on a case-by-case basis. Currently, if a structure removal involves the use of explosives, an environmental assessment is prepared and an Endangered Species Section 7 Consultation is initiated with NMFS. The NMFS issued a "standard" Biological Opinion on July 25, 1988, which covers removal operations that meet specified criteria pertaining to the size of explosive charge used, detonation depth, and number of blasts per structure grouping. The MMS, NMFS, and lessees are cooperating in an observer/monitoring program to determine the presence of protected marine mammals and/or endangered sea turtles in the vicinity of the structure removals. Additional information on structure removals is found in Section IV.A.3.b.(3).

(2) *Enforcement Measures*

(a) Inspections

The OCSLA (43 U.S.C. 1348(c)) requires MMS to conduct onsite inspections before, during, and after operations to assure compliance with lease terms, NTL's, and approved plans and to assure that safety and pollution-prevention requirements of regulations are met. These inspections also involve additional items of environmental concern. Further information on the baseline for the inspection of lessee operations and facilities can be found in the National Potential Incident of Noncompliance (PINC) List (USDI, MMS, 1988a). Noncompliance with checklisted requirements for specific installations or procedures is followed by prescribed enforcement actions consisting of written warnings or shut-ins of platforms, zones (wells), equipment, or pipelines. In some cases, more than one enforcement action is noted. The MMS inspector then determines the appropriate enforcement action based on an assessment of the risk of either pollution or accident, the history of the lessee, the stage of operation in progress, and the status of other systems. The MMS conducted 7,648 inspections in the Gulf during FY 89.

The primary objective of initial inspections is to assure proper installation of mobile units or structures and associated equipment. After operations begin, additional announced and unannounced inspections are held. Depending on the distance from shore and other factors such as weather and proximity to other inspections, MMS district personnel inspect from one to three different rigs or platforms per day. Aerial surveillance of additional offshore structures is conducted enroute. Annual inspections are conducted on all platforms, but more frequent inspections may be conducted on rigs and platforms. On-board inspections also involve the inspection of all safety systems of a production platform.

The operator will normally request the use of oil-based (e.g., mineral oil or polymers) muds at the APD stage if problems are anticipated or if problems are encountered during drilling. Cuttings associated with oil-based muds are generally transported to shore for disposal. Drilling mud is usually reused because of its high cost. Inspectors try to visit operations using oil-based muds frequently or at least make an effort to "fly-by" when in the area. Of initial importance to inspectors is the presence or absence of a "visible sheen" in the waters adjacent to a rig using oil-based muds or a platform producing hydrocarbons. On-board inspection involves seeing that the muds and cuttings are being properly treated and/or disposed of. The "bucket test" involves dropping 2-3 handfuls of cuttings into a bucket of seawater to test for residual oil. The bucket test is a crude indication of the level of treatment when cuttings are treated prior to discharge offshore. The bucket test may be used to ensure that water-based muds will not cause a sheer. The presence or absence of a "visible sheen" in the bucket determines whether or not the cuttings are being properly treated prior to being dumped. This sheen test, performed by MMS inspectors, is different than the "visible sheen" test required under the U.S. Environmental Protection Agency's NPDES general permit for the Gulf of Mexico.

District personnel inspect H_2S sensors to make sure that they are operational and inspect logs for timely calibration of instruments and to ensure that rig personnel have been trained in appropriate equipment handling, safety regulations, and emergency procedures. The revised rule for H_2S protection requirements and procedures has been expanded to include production, well-completion, and well-workover operations as well as drilling operations. Hydrogen sulfide presents a threat to human life and safety and to the survival of equipment.

(b) Suspension of Operations

The OCSLA, as amended (43 U.S.C. 1334(a)(1)), and regulations appearing at 30 CFR 250.10 provide for the suspension or temporary prohibition of an operation or activity when the suspension is in the national interest and when the suspension is necessary based on any of the conditions given at 30 CFR 250.10(a) through (k).

(c) Cancellation of Leases

The OCSLA (43 U.S.C. 1334(a)(2)) and regulations at 30 CFR 250.12 authorize the Secretary to cancel a lease or permit if, after opportunity and notice for a hearing, he determines (1) continued activity would probably cause serious harm or damage to life, property, the environment, or national security or defense; (2) the threat of harm or damage will not disappear or decrease to an acceptable extent within a reasonable time; (3) the advantages of cancellation outweigh the advantages of continued activity; and (4) the suspension has been in effect for at least 5 years or the termination of suspension and lease cancellation are at the request of the lessee.

(d) Remedies and Penalties

Under 43 U.S.C. 1350 of the OCSLA, as amended, and regulations appearing at 30 CFR 250.200-.206, civil penalties can be assessed for failure to comply with responsibilities under the law, a license, a permit, or any regulation or order issued pursuant to the Act. Further, the issuance and continuance in effect of any lease or of any assignment or other transfer of any lease shall be conditioned upon compliance with regulations issued under the OCSLA.

(3) Environmental Safeguards

(a) OCS Regulations

On April 1, 1988, revised regulations (30 CFR 250 and 256) that restructured and consolidated the rules governing OCS exploration, development, and production activities were published in the *Federal Register*. These rules were effective May 31, 1988. The former Gulf of Mexico OCS Orders, which dealt with the technical aspects of OCS activities, have been incorporated into the new rules (53 FR 10596-10777). Until Subpart P is finalized, sulphur operations are covered under Subpart D of the operating regulations.

(1) Approvals

The Director, MMS, is authorized to act upon the requests, applications, and notices submitted to the agency to issue either written or oral orders to govern lease and right-of-way operations. He is also authorized to require compliance with applicable laws, regulations, and lease terms so that all operations conform to sound conservation practice and are conducted in a manner that will preserve, protect, and develop mineral resources of the OCS.

(2) Best Available and Safest Technologies

To assure that oil and gas exploration, development, and production activities on the OCS are conducted in a safe and pollution-free manner, 43 U.S.C. 1347(b) of the OCSLA, as amended, requires that all OCS technologies and operations use the best available and safest technology (BAST) that the Secretary determines to be economically feasible. Conformance to the standards, codes, and practices referenced in 30 CFR 250 are considered to be the application of BAST. These include requirements for state-of-the-art drilling technology, production safety systems, completion of oil and gas wells, oil-spill contingency plans, pollution-control equipment, and specifications for platform/structure designs. The MMS conducts periodic offshore inspections; and the Rules, Orders, and Standards section continuously and systematically reviews OCS technologies to ensure that the best available and safest technologies are applied to OCS operations. The BAST is not required when the Secretary determines that the incremental benefits are clearly insufficient to justify increased costs (30 CFR 250.5(b)); however, it is the responsibility of an operator on an existing operation to demonstrate why application of a new technology would not be feasible. This requirement is applicable to equipment and procedures that, if failed, would have a significant effect on safety, health, or the environment, unless benefits clearly do not justify the cost.

The BAST concept is addressed in the Gulf of Mexico OCS Region by a continuous effort to locate and evaluate the latest technologies and to report on these advances at periodic Regional Operations Technology Assessment Committee (ROTAC) Meetings. A part of the MMS staff has an ongoing function to evaluate various vendors and industry representatives' innovations and improvements in techniques, tools, equipment, procedures, and technologies applicable to oil and gas operations (drilling, producing, completion, and workover operations). This information is provided to MMS district personnel at ROTAC meetings. The requirement for the use of BAST has, for the most part, been an evolutionary process whereby advances in equipment, technologies, and procedures have been subtly integrated into OCS operations over a period of time. An awareness by both MMS inspectors and the OCS operators of the most advanced equipment and technologies has resulted in the incorporation of these advances into day-to-day operations. An example of such an equipment change that evolved over a period of time would be the upgrading of diverter systems on drilling rigs from the smaller diameter systems of the past to the large-diameter, high-capacity systems found on drilling rigs operating on the OCS today. Another example of a BAST-required equipment change would be the requirement to replace subsurface-controlled safety valves with surface-controlled, subsurface safety-valve systems, which incorporate a more positive closure design and operation. Also, a quality assurance and performance of safety and pollution-prevention equipment program regarding the surface and subsurface safety valves has been included in MMS requirements.

(3) Pollution Prevention and Control

The MMS has promulgated regulations (30 CFR 250.40) to assure lessees do not create conditions that will pose an unreasonable risk to public health, life, property, aquatic life, wildlife, recreation, navigation, commercial fishing, or other uses of the ocean during offshore oil and gas operations. Control and removal of pollution is the responsibility and expense of the lessee. Operators are required to install curbs, gutters, drip pans, and drains on platform and rig deck areas in a manner necessary to collect all contaminants and debris not authorized for discharge. The rules also explicitly prohibit the disposal of equipment, cables, chains, containers, or other materials into offshore waters. Portable equipment, spools or reels, drums, pallets, and other loose items weighing 40 lb or more must be marked in a durable manner with the owner's name prior to use or transport over offshore waters. Smaller objects must be stored in a marked container when not in use. Should equipment, material, containers, drums, or other items be lost overboard, they are to be recorded on the facility's daily report and reported to the MMS. Discussion of regulations specifically pertaining to oil-spill prevention can be found in Section IV.C.5.

(b) Lease Stipulations

Oil and gas exploration and development activities on the OCS have the potential for causing adverse environmental impacts; therefore, stipulations are developed before the sale (discussed in Sections II and IV) and are attached to the lease instrument, as necessary, in the form of additional mitigating measures. Biological features, archaeological resources, and military areas stipulations are those that have been attached most often to the leases in previous Gulf lease sales. The MMS is responsible for ensuring full compliance with stipulations appended to leases.

(c) Other Environmental Safety Controls

Besides its regulations and lease stipulations, MMS has other mechanisms that may be used to control or mitigate environmental or safety problems that may arise.

(1) Notices, Letters, and Information to Lessees and Operators

Notices to Lessees and Operators (NTL's) are formal documents that provide clarification, description, or interpretation of a regulation or OCS standard; provide guidelines on the implementation of a special lease stipulation or regional requirement; provide a better understanding of the scope and meaning of a regulation by explaining MMS interpretation of a requirement; or transmit administrative information such as current telephone listings and a change in MMS personnel or office address. A detailed listing of current and effective

Gulf of Mexico NTL's was published in the *Federal Register* on June 27, 1989 (54 FR 27071-27072). NTL 89-01, adopted subsequent to the latest publication, concerns the Implementation of Consistent Biological Stipulation Measures in the Central and Western Gulf of Mexico. The MMS publishes an updated NTL listing annually in the *Federal Register*.

The MMS also conveys important information by way of Letters to Lessees and Operators (LTL's) and Information to Lessees and Operators (ITL's). These documents further clarify or supplement operational guidelines. Separate Regional mailings and the EIS process have served as the vehicles for communicating previous NTL's, LTL's, and ITL's that have been issued.

(2) Conditions of Approval

Conditions of plan approval are mechanisms used by MMS to control or mitigate potential environmental or safety problems associated with a proposal. These mechanisms represent an integration of review results from other Federal and State agencies (as applicable) and MMS technical evaluations (including geological and geophysical; royalty, Suspension of Production schedule, and competitive reservoir considerations; potentially hazardous situations involving existing or proposed pipelines; conflicts with archaeological resources and sensitive biological areas, and other uses; and NEPA compliance.

Alternatives to a proposed action are evaluated as part of the NEPA process to assess reasonable alternative activities that could result in lower adverse environmental impacts. In addition to alternatives proposed by the lessee/applicant, alternatives that consider other uses of resources that involve unresolved conflicts, as well as alternatives or mitigation that are not part of the proposal that may be needed to minimize environmental effects, are given full consideration. Mitigating measures have addressed resource-use concerns such as endangered/threatened species, geologic and manmade hazards, military warning and ordnance disposal areas, oil-spill contingency planning, chemosynthetic communities, operations in H_2S prone areas, and shunting of drill effluents in the vicinity of biologically sensitive features.

Conditions that may be necessary to provide environmental protection may be applied to any OCS plan, permit, or right of use of easement.

(3) Personnel Training and Education

An important factor in ensuring that offshore oil and gas operations are carried out in a manner that emphasizes operational safety and minimizes the risk of environmental damage is the proper training of personnel. Under 30 CFR 250.43(a), all operators must have trained personnel to operate oil-spill cleanup equipment or must have retained a trained contractor(s) that will operate the equipment for them. The Drilling Well-Control Training Program, now incorporated under 30 CFR 250.211, was instituted by MMS in 1979. In 1982 and 1983, an additional training program--the Safety Device Training Program--was developed and put into effect. The Safety Device Training Program, incorporated under 30 CFR 250.212(a), ensures that personnel involved in installing, inspecting, testing, and maintaining safety devices are qualified.

(d) Federal Compensation for Oil- and Gas-related Damage

(1) Offshore Oil Pollution Compensation Fund

Title III of the OCSLA, as amended (43 U.S.C. 1812-1824), provides an offshore oil-spill liability fund for actual costs of oil removal and cleanup, as well as replacement or restoration costs of natural resources damaged or destroyed by a spill. A fee of no more than three cents per barrel of oil obtained from the OCS is levied by the Secretary of Transportation and collected by the Secretary of the Treasury. This fee is imposed on the owner of the oil when such oil is produced. Fees levied on oil obtained from the OCS are designed to ensure that the Fund is maintained at a level not less than $100 million or more than $200 million.

Claims may generally be asserted by any claimant for the following: removal cost; damages, including injury to or destruction of real or personal property; loss of use of real or personal property; injury to, destruction of, or loss of use of natural resources; loss of profits or impairment of earning capacity; and/or loss of tax revenue.

Owners/operators of nonpublic vessels transporting OCS oil and owners/operators of offshore facilities are held strictly liable for claims attributable to oil pollution from their vessels or facilities. Except in cases of gross negligence, willful misconduct, or violation of Federal regulations, liability is limited in the case of vessels to the greater of $250,000 or $300 per gross ton; and in the case of an offshore facility, liability is limited to the total of cleanup and removal costs, and $35 million in damages.

(2) U.S. Coast Guard's Pollution Revolving Fund

The Federal Water Pollution Control Act (FWPCA), as amended (33 U.S.C. 1321(k)), provides for a $35 million contingency fund for the removal and cleanup of oil as hazardous substances from waters of the United States when the discharger is unknown or his cleanup actions are inadequate. The funds are also appropriated to address pollution hazards resulting from maritime disasters and the administration of removal and cleanup activities. This oil-spill liability fund is administered by the USCG. Under the law, a known discharger may be responsible for reimbursing the Fund for actual costs incurred. Penalties collected for violation of 33 U.S.C. 1321 are placed back into the Fund; thus, the Fund is said to be "revolving."

(3) Fishermen's Contingency Fund

Final regulations for the implementation of Title IV of the OCSLA, as amended (43 U.S.C. 1841-1846), were published in the *Federal Register* on January 24, 1980 (45 FR 6062). The OCSLA, as amended, established this Fund (not to exceed $2 million) to compensate commercial fishermen for actual and consequential damages including loss of profit due to damage or loss of fishing gear by various materials and items associated with oil and gas exploration, development, or production on the OCS. This Fund is administered by the USDC, NOAA, Financial Services Division, National Marine Fisheries Service. It mitigates most losses suffered by commercial fishermen due to OCS oil and gas activities.

As required in the Act, nine area accounts have been established--five in the Gulf of Mexico, one in the Pacific, one in Alaska, and two in the Atlantic. The five Gulf accounts cover the same areas as the five MMS Gulf OCS Districts. Each area account is initially funded at $100,000 and cannot exceed this amount. It is initiated and maintained by assessing holders of leases, pipeline rights-of-way and easements, and exploration permits. These assessments cannot exceed $5,000 per operator in any calendar year.

The claims eligible for compensation are generally contingent upon the following: (a) damages or loss must be suffered by a commercial fisherman; and (b) any actual or consequential damages including loss of profit must be due to damages or loss of fishing gear by items or obstructions related to OCS oil and gas activities. Damages or losses that occur in non-OCS waters may be eligible for compensation if the item(s) causing damages or losses were associated with OCS oil and gas activities.

The claims ineligible for compensation are generally: (a) damages or losses caused by items that are attributable to a financially responsible party; (b) damages or losses caused by negligence or fault of the commercial fishermen; (c) occurrences before September 18, 1978; (d) claims of damages to, or losses of fishing gear exceeding the replacement value of the fishing gear; (e) claims for loss of profits in excess of 6 months, unless supported by records of the claimant's profits during the previous 12 months; (f) claims or any portions of damages or loss claimed that will be compensated by insurance; (g) those claims not filed within 60 days of the event of the damages or losses; and (h) damages or losses caused by natural obstructions or obstructions unrelated to OCS oil and gas activities.

There are several requirements for filing claims, including one that a report must be made within 5 days after the event of the damages or losses, stating among other things the location of the obstruction; this 5-day report is required to gain presumption of causation. A detailed claim form must be filed within 60 days of the event of the damages or losses. The specifics of this claim are contained in 45 FR 6062. The claimant has the burden of establishing all the facts demonstrating eligibility for compensation, including the identity or nature of the item that caused the damages or losses and its association with OCS oil and gas activity.

Damages or losses are presumed to be caused by items associated with OCS oil and gas activities provided the claimant establishes that: (a) the commercial fishing vessel was being used for commercial fishing and was located in an area affected by OCS oil and gas activities; (b) the 5-day report was filed; (c) there is no record in the most recent NOAA/NOS nautical charts or weekly USCG Notice to Mariners of an obstruction in the immediate vicinity; and (d) no proper surface marker or lighted buoy marked the obstruction. Damages or losses occurring within a one-quarter-mile radius of obstructions recorded on charts, listed in the Notice to Mariners, or properly marked are presumed to involve the recorded obstruction.

4. Other Federal Agency Regulatory/Administrative Measures

a. Ports and Waterways Safety Act

The Ports and Waterways Safety Act (33 U.S.C. 1221-1232) promotes the safety of ports, harbors, waterfront areas, and navigable waters of the United States. The Act was amended by the Ports and Tanker Safety Act (92 Stat. 1471) in 1978 to expand the authority of the Act to the protection of navigation and vessel safety and to the protection of the marine environment.

The Act authorizes increased supervision of vessel and port operations to reduce vessel or cargo loss; to prevent damage to life, property, or the marine environment; and to prevent damage to structures in, on, or immediately adjacent to the navigable waters of the United States or the resources within such waters. It also requires that the Secretary of Transportation ensure that vessels operating in U.S. navigable waters comply with all applicable standards and requirements for vessel construction, equipment, manning and operational procedures, and that the handling of dangerous articles and substances within navigable waters be conducted within established standards and requirements.

The Act authorizes the Coast Guard to designate necessary safety fairways and traffic separation schemes (TSS's) to allow vessels unobstructed, safe access to U.S. ports. Safety fairways are areas in which no fixed structures are permitted and, therefore, may inhibit exploration and exploitation of mineral resources in the designated areas. Fairways may be viewed as a necessary compromise between convenient mineral exploitation and concern for navigation safety. The TSS's are designed to increase navigation safety by separating opposing lanes of vessel traffic. In order to ensure that the interests of all affected parties are considered, the Act mandates that a port access route study be conducted when new fairway areas or TSS's are contemplated. Publication of a study notice advises all bidders in future lease sales within the study area that occupancy rights may be restricted by a routing system developed as a result of the study. The USCG must also consult with DOI to reconcile the need for safe access routes with the needs of all other reasonable uses of the area involved. Lessees are advised that the USCG may designate necessary fairways through leased blocks.

b. OCS Pipelines

Regulatory processes and jurisdictional limitations concerning pipelines on the OCS and in coastal areas are shared by several Federal agencies (DOI, Dept. of Transportation (DOT), Federal Energy Regulatory Commission (FERC), U.S. Army Corps of Engineers (COE), and USCG). Aside from pipeline regulations, these agencies have the responsibility of overseeing and regulating the following areas: the placement of structures on the OCS and pipelines in areas that affect navigation; the certification of proposed projects involving the transportation or sale of interstate natural gas, including OCS gas; the right of eminent domain exercised by pipeline companies; and wellhead pricing controls for certain gas produced on the OCS. In addition, the Materials Transportation Bureau is responsible for promulgating and enforcing safety regulations for the transportation in or affecting interstate commerce of natural gas, liquefied natural gas (LNG), and hazardous liquids by pipeline. This includes all offshore pipelines on State lands beneath navigable waters and on the OCS. The regulations are contained in 49 CFR 191-193 and 195. Prior to May 1989, MMS requested that affected States render a Coastal Zone Management consistency determination for offshore right-of-way pipeline applications. Since the publication of CFR 250, Subpart J, in May 1989, which did not explicitly state that a consistency determination was required for pipeline applications, MMS has not requested such determinations from the affected States.

There is a Memorandum of Understanding (MOU) between DOT and DOI that gives recognition to each party's respective regulatory responsibilities. Basically, DOT is responsible for establishing and enforcing design, construction, operation, and maintenance regulations for pipelines extending to the shore from the outlet flange of an offshore facility. The DOI responsibility extends upstream from the outlet flange.

c. Coastal Zone Management

Background

The Coastal Zone Management Act (CZMA) (16 U.S.C. 1451 et seq.) was enacted by Congress in 1972 to improve the nation's management of coastal resources, which were being irretrievably damaged or lost due to poorly planned development. Specific concerns were the loss of living marine resources and wildlife habitat, decreasing open space for public use, and shoreline erosion. Congress also recognized the need to resolve conflicts between various uses that were competing for coastal lands and waters (USDC, NOAA, 1988a).

A major CZM issue has been what is meant by "directly affecting the coastal zone." The NOAA has concluded that "affecting the coastal zone" means "influencing or altering a physical characteristic of the land or water." "Directly" is defined as "without intervening cause." This was interpreted to mean without another Federal agency decision. Examples of activities that meet the test include construction of a Federal facility and COE dredging. In January 1984, the U.S. Supreme Court ruled that preleasing activities and lease sales are not subject to CZM consistency.

The basic goal of the CZMA is to encourage coastal states to voluntarily develop comprehensive management programs. The CZMA establishes a State-Federal partnership in which the States take the lead in managing their coastal resources, while the Federal Government provides financial and technical assistance and agrees to act in a manner consistent with the federally-approved State management programs. The law also establishes a National Estuarine Reserve Research System with specific estuarine sites designated across the nation. The CZMA is implemented by the Office of Ocean and Coastal Resource Management (OCRM), within NOAA's National Ocean Service.

At the State level, a lead State agency oversees implementation of the CZM program and administers the Federal grant funds. Local governments are involved in the implementation of State CZM programs, either formally or informally. Federal agencies are involved in the development and implementation of State CZM programs. Once the programs are federally approved, Federal agencies must ensure that their actions are consistent with the State programs. State and Federal agencies work together on joint planning and permitting, which reduces the regulatory burden on the public (USDC, NOAA, 1989a).

The role of the Federal agency includes State assistance, approval determination, review and approval of financial assistance, continued monitoring and formal evaluations, review and approval of program changes, mediation, and consistency appeals. Section 305 programs previously funded State coastal management program planning. Projects conducted under Section 306 of the CZMA, which funds State coastal management program implementation, include hazards protection, natural resource protection and development, public access, urban waterfront redevelopment, ports and marinas, and improved government operations. The State must submit Routine Program Implementations to the OCRM on a case-by-case basis, periodically or annually. On the average, one out of four of these are accepted. The NOAA evaluates the program changes, lack of Federal agency involvement in the State review process, early consultation with the OCRM, and the content of submissions. Amendments must by submitted by the Governor of a State or by the head of an agency. At least one public hearing must be held with a 30-day notice. Section 307 of the CZMA contains the Federal consistency provisions, which impose certain requirements on Federal agencies to comply with approved State CZM programs. Section 308 previously funded Coastal Energy Impact Mitigation projects. Section 312 provides for periodic reviews. Section 315 funds the National Estuarine Research Reserve Acquisition and Development program.

Important amendments were made to the CZMA in 1976 and 1980. In 1976, Section 302(i) added the attainment of a greater degree of energy self-sufficiency as one of the basic purposes of the program. This element has been important in administrative appeals to the Secretary of Commerce. Amendments to consistency provisions were adopted (Section 307(c)(3)(B)) to give expedited review and approval of OCS plans. Section 306(c)(8) was modified to make the national interest provisions a specific requirement for the preparation of a plan for siting the energy facilities necessary to meet requirements that are other than local. Section 308 established the Coastal Energy Impact Fund to assist the States in planning and facility development necessary to accommodate the impacts of large-scale energy facilities, especially OCS facilities. A 1980 amendment encouraged special area-management plans, which would allow reasonable coastal-dependent economic growth. The Secretary was also authorized to cut off funding to States that failed to make satisfactory progress in program improvement. Section 312 was amended to upgrade the responsibilities of the Department of Commerce to review performance under State CZM programs. The MMS has major responsibilities concerning CZM consistency and biennial reviews of State program implementation.

State Coastal Zone Management Programs

Of the five States affected by the proposed sales, only Texas does not have an approved CZM plan. In May 1981, the State of Texas formally withdrew from the Federal CZM program. The State has a network of 14 agencies involved in the regulation of coastal resources, including the Air Control Board, Parks and Wildlife, Water Commission, Health Department (marine life), Office of the Governor (Energy Advisor and Budget and Planning Offices), General Land Office (environmental protection), and the Railroad Commission (regulation of oil and gas activities).

State of Florida Coastal Management Program

The Florida Coastal Management Program (FCMP) was approved on September 24, 1981. The entire State and its territorial waters are included within the coastal-zone boundary. The FCMP, as required by State-enabling legislation, is based upon existing State laws. Twenty-five statutes specifically serve as the authorities for a direct State-control management technique. The Department of Environmental Regulation (DER), the designated CZM agency, works closely with the Departments of Natural Resources and Veteran and Community Affairs in implementing the FCMP. Instrumental in the coordination of State government and policy development is the Interagency Management Committee, which is an advisory body composed of the heads of the State agencies that have responsibilities for resource-management activities.

State of Alabama Coastal Area Management Program

The Alabama Coastal Area Management Program (ACAMP) was approved on September 25, 1979. The Alabama Coastal Area Act established the Coastal Area Board, mandated the development of a comprehensive management program, and established the coastal area from the contiguous 10-ft inland contour to the seaward limit of the State's territorial water including the coastal islands. The ACAMP policies encourage the balance between development and the protection of coastal resources. The 1982 State legislature passed legislation to create a new Department of Environmental Management. Various functions of the Coastal Area Board were transferred to the Department of Environmental Management and the Department of Economic and Community Affairs in an effort to streamline the permitting process and to consolidate the environmental regulatory programs. The Department of Economic and Community Affairs is the designated agency for the Section 306 and 308 programs.

State of Mississippi Coastal Program

The Mississippi Coastal Program was approved in September 1980 and is based, in large part, on the Mississippi Coastal Wetlands Protection Law and the Mississippi Marine Resource Council enabling legislation. The Bureau of Marine Resources administers the major portions of the program. Collectively, three coastal-program agencies--the Bureau of Marine Resources and the Bureau of Pollution Control and Land and Water Resources, both in the Department of Natural Resources, and the Department of Archives and History--are responsible for monitoring decisions that affect the coastal area and for ensuring that such decisions are made in accordance with the program's goals. For the purposes of the coastal program, the boundary encompasses the three coastal counties of Hancock, Harrison, and Jackson and all coastal waters.

State of Louisiana Coastal Resources Program

The Louisiana Coastal Resources Program (LCRP) was approved in September 1980 and is based on the State and Local Coastal Resources Management Act of 1978, as well as other preexisting State laws that are incorporated into the program. The boundary of the coastal zone includes all or part of the 19 coastal parishes and totals 5.3 million acres. The program is implemented primarily by the State through the coastal-use permit program and preexisting State permits. Local governments have the option of assuming responsibility for the permitting of a certain class of uses by developing a local coastal program that is consistent with State coastal policy.

Gulf of Mexico OCS Region's Procedures for CZM Consistency

Pursuant to the CZMA, 16 U.S.C. 1451 et. seq. (Section 307), a State with an approved CZM plan reviews certain OCS activities to determine whether they will be conducted in a manner consistent with their approved plan. This review authority is applicable to activities described in detail in any plan for the exploration or development of any area that has been leased under the OCSLA and that affects any land or water use of the State's coastal zone (16 U.S.C. 1456(c)(3)(b)). The MMS may not issue a permit for activities described in a plan unless the State concurs or is conclusively presumed to have concurred that the plan is consistent with its CZM plan (43 U.S.C. 1340 (c) and 1351(d); 16 U.S.C. 1456(c)(3)).

In accordance with the requirements of 15 CFR 930.76(b), the MMS Gulf of Mexico OCS Region sends copies of a proposed plan of exploration, plan of development and production, and development operations coordination document--including the consistency certification and other necessary information--to the designated State CZM agency by receipted mail. Refer to Section I.B.3.b.(1)(e) for a discussion of environmental information requirements for leases in the Gulf of Mexico for CZM purposes. The Region monitors the consistency-review time period since 15 CFR 930.79(a) and (b) require that concurrence by the State agency shall be conclusively presumed in the absence of a State-agency objection when the appropriate review period expires. Similar procedures are followed for amended plans.

If a written consistency concurrence is received from the State, the Region may then approve any permit for activities described in the plan in accordance with 15 CFR 930.63(c). If the Gulf of Mexico OCS Region receives a written concurrence stating that the plan is consistent only if specified changes are made or if certain conditions are met, MMS will consider the State response to be a full concurrence and may then approve any permit for activities described in the plan without imposing the changes or conditions suggested by the State. The Gulf Region does not impose or enforce additional State conditions when issuing permits. The MMS can require modification of a plan even if the operator has agreed to certain requirements requested by the State and agreed to by the operator.

If the Gulf Region receives a written consistency objection from the State containing all the items required in 15 CFR 930.79(c) before the expiration of the review period, the Region will not approve any permit for an activity described in the plan unless (1) the operator amends the plan to accommodate the objection in accordance with 15 CFR 930.83 and concurrence is subsequently received or conclusively presumed; (2) upon appeal, the Secretary of Commerce, in accordance with 15 CFR 930.120, finds that the plan is consistent with the objectives or purposes of the CZMA or is necessary in the interest of national security; or (3) the original objection is declared invalid by the courts.

Coastal Zone Consistency Appeals

A State determination that a proposed activity is not consistent with its approved program must be made within 6 months, and the State must notify the applicant. States often object on the grounds that the State claims it has insufficient information or that the proposal is inconsistent with a mandatory State program requirement. The State objection must describe (1) how the proposed activity will be inconsistent with specific elements of the management program and (2) alternative measures, if they exist, which, if adopted by the applicant, would permit the proposed activity to be conducted in a manner consistent with the management program. Further, the State must inform the applicant of the right of appeal to the Secretary of Commerce (15 CFR 930.64).

The applicant has 30 days from receipt of the objection to file a notice of appeal with the Secretary. The applicant may appeal on two independent grounds. First, the applicant may state that the activity furthers the purposes or objectives of the CZMA or, second, that the activity is necessary in the interest of national security. The notice of appeal must be accompanied by a statement in support of the applicant's position, along with supporting data and information. Copies of the notice and supporting material must be sent to relevant Federal and State agencies. An Ex-Parte process applies to appeals to the Department of Commerce. The merits of an appeal cannot be discussed unless all parties are present (OCRM exempted).

The Secretary may order a public hearing on his own volition or at the request of an interested party. If the Secretary holds a hearing, the NOAA General Counsel or his designee presides as hearing officer. A *Federal Register* notice is prepared to inform the public of the hearing. The regulations covering the appeals process are found at 15 CFR 930, Subpart H.

d. Archaeological Resources Legislation

The Federal Government's involvement in archaeological resource management and protection on the OCS is based on the requirements of the National Historic Preservation Act of 1966, as amended. This Act states, in effect, that any Federal agency, before approving federally permitted or federally funded undertakings, must take into consideration the effect of that undertaking on any property listed on, or eligible for, the National Register of Historic Places. Implied in this legislation and Executive Order 11593 is that an effort be made to locate such sites before development of an area. Section 11(g)(3) of the OCSLA, as amended, states that "such exploration (oil and gas) will not . . . disturb any site, structure, or object of historical or archaeological significance."

e. Endangered Species Act of 1973

The Endangered Species Act of 1973 (16 U.S.C. 1531-1543), as amended in 1982, establishes a national policy designed to protect and conserve threatened and endangered species and the ecosystem upon which they depend. This Act is administered by FWS and NMFS. Section 7 of the Act, governing interagency cooperation, requires Federal agencies to formally consult with NMFS and FWS when there is reason to believe that a species, which is on the list as endangered or threatened (or is proposed to be listed as such), may be affected by a proposed action. Agencies must ensure that proposed actions are unlikely to jeopardize the continued existence of a threatened or endangered species and/or to result in adverse modification or destruction of their critical habitat.

Under Section 7, formal endangered species consultation with both NMFS and FWS, as appropriate, is required to provide a threshold examination and biological opinion on the likelihood of whether or not the proposed activity will jeopardize the continued existence of the species or critical habitat. The biological opinion may include recommendations for modification of the proposed activity. The current conservation recommendations from FWS request that MMS continue to require adequate oil spill contingency plans for all activities and urge that aircraft supporting offshore facilities fly at altitudes of 2,000 ft or more above National Park lands. The MMS has responded by continuing to require that oil spill contingency plans address the removal of sea turtle eggs from imminently oiled beaches, strategic placement of cleanup equipment, training of cleanup personnel, and demonstration of response capabilities. The MMS also notifies its lessees of the recommended minimum flight ceiling over National Wildlife Refuges, National Parks, and National Seashores. If insufficient information is available, as a result of the threshold examination, to conclude that the proposed activity is unlikely to jeopardize the species or its habitat, the Federal agency is notified in writing. The affected agency is then required to obtain additional information and, if recommended by NMFS or FWS, will conduct appropriate biological surveys or studies to determine how the proposed activity may affect the endangered species or its critical habitat. After such additional information is received, NMFS or FWS would conclude the consultation process by issuance of a formal biological opinion.

f. Marine Mammal Protection Act of 1972

The Marine Mammal Protection Act of 1972 (16 U.S.C. 1361 et seq.), as amended, establishes a national policy designed to protect and conserve marine mammals and their habitats. This policy is established so as not to diminish such species or population stocks beyond the point at which they cease to be a significant, functioning element in the ecosystem, nor to diminish such species below their optimum sustainable population. The Marine Mammal Commission is responsible for reviewing and advising Federal agencies on the protection and conservation of marine mammals. The Commission has a Committee of Scientific Advisors, which provides advice on actions needed to fulfill the purposes of the Act.

The Act authorizes the Commission to make recommendations on the prohibition of the taking and importation of marine mammals and marine mammal products, except as expressly provided for by an international treaty, convention, or agreement to which the United States is a party. The Act provides certain exemptions to the taking of marine mammals by Alaskan natives under certain conditions. Authority for administering the Act has been delegated both to NMFS, which is responsible for all cetaceans and pinnipeds (except walruses), and to FWS, which is responsible for walruses, sea otters, manatees, and dugongs.

g. Magnuson Fishery Conservation and Management Act of 1976

The Magnuson Fishery Conservation and Management Act of 1976 (MFCMA) (16 U.S.C. 1801-1882) established a fisheries conservation zone for the United States and its possessions and delineates an area from the States' seaward boundary out 200 nmi. The Act created eight Regional Fisheries Management Councils (FMC) and mandated a continuing planning program for marine fisheries management by the Councils. As a part of this program, a Fishery Management Plan (FMP) must be prepared for each species (or related group of species) of fish harvested within each respective region. The Act, as amended, requires that a FMP based upon the best available scientific and economic data be prepared for each commercial species (or related group of species) of fish that is in need of conservation and management within each respective region.

Based on Congressional direction, the MFCMA must be reauthorized every few years and was up for reauthorization during 1989. At the time of the reauthorization, Congress also considers amendments to the Act that will update and improve the fishery management system. The individual FMC's also take part in the process by recommending changes to the Act that they believe necessary to improve the fisheries management system. The Gulf of Mexico FMC recommended 14 amendments, many of which addressed budgeting, funding, administrative, and data-gathering concerns. The important fisheries recommendation from the Gulf of Mexico FMC was an amendment to include tuna under the MFCMA. Tuna are excluded at this time under Section 102 because they are a highly migratory species; however, landings for tuna have increased exponentially in the Gulf during the past 5 years. The Gulf of Mexico FMC believes tuna are in need of a management plan but cannot manage the species until it is included under the Act. The Congress is expected to reauthorize the Act and will decide individual issues in early 1990.

To date, eight FMP's have been implemented. The FMP for shrimp was implemented in 1981; for stone crab, in 1982; for spiny lobster, in 1982; for coastal pelagic fish, in 1983; for coral, in 1984; for reef fish, in 1984; for swordfish, in 1985; and for red drum, in 1987. The FMP's are amended and updated as new information from studies and public input is received and assessed.

h. National Fishing Enhancement Act of 1984

Title II of Public Law 98-623, also known as the Artificial Reef Act, establishes broad artificial-reef development standards and a National policy of the United States to encourage the development of artificial reefs that will enhance fishery resources and commercial and recreational fishing. The Secretary of Commerce provided leadership in developing a National Artificial Reef Plan that identifies design, construction, siting, and maintenance criteria for artificial reefs and provides a synopsis of existing information and future research needs. The Secretary of the Army issues permits to responsible applicants for reef development projects in accordance with the National Plan, as well as Regional, State, and local criteria and plans. The law also limits the liability of reef developers complying with permit requirements and amends the Reefs for Marine Life Conservation Law to include the availability of all surplus Federal ships for consideration as reef development materials. Although the Act mentions no specific materials other than ships for use in reef development projects, the Secretary of the Interior cooperated with the Secretary of Commerce in developing the National Plan, which identifies oil and gas structures as acceptable materials of opportunity for artificial-reef development. The MMS adopted a Rigs-to-Reefs policy in 1985 in response to this Act and to broaden interest in the use of petroleum platforms as artificial reefs.

i. Federal Water Pollution Control Act (Clean Water Act)

The Federal Water Pollution Control Act of 1972 (33 U.S.C. 1251 et seq.), as amended (FWPCA), and commonly called the Clean Water Act, provides a major tool to the Federal Government to ensure that the chemical, physical, and biological integrity of the Nation's waters are maintained.

The Act provides a comprehensive plan for dealing with oil spills and discharges of oil and oil-containing substances into both coastal and inshore navigable and OCS waters. Title III of the FWPCA requires the U.S. Environmental Protection Agency (USEPA) to establish national effluent limitation standards for point sources of wastewater discharges. Section 311 of the Act, as amended, prohibits the discharge of oil or hazardous substances, which may affect the natural resources, into the waters under United States jurisdiction, except under limited circumstances. Title IV of the Act establishes requirements for Federal permits and licenses to conduct an activity (including construction or operation of facilities) that may result in any discharges into waters, called the National Pollutant Discharge Elimination System (NPDES). Section 402 of the Act confers authority upon USEPA to issue permits for the discharge of pollutants into territorial seas and oceans only when the discharges are in compliance with the ocean discharge criteria guidelines established under the authority of Section 403(c) of the Act.

On July 9, 1986, USEPA issued an NPDES general permit for the Gulf of Mexico. This general permit establishes effluent limitations, prohibitions, reporting requirements, and other conditions on discharges from oil and gas facilities on the OCS (beyond the territorial sea boundary). Section IV.A.3.e. describes the permit requirements in more detail. The USEPA is currently in the process of revising the general permit and expects the modified permit to be published in proposed form in FY 1990. New effluent limitations will be set for cadmium and mercury. Furthermore, USEPA plans to publish proposed coastal general permits regulating the discharges of exploration and development activities, followed by coastal general permits for production activities for Texas and Louisiana during FY 1991.

The FWPCA addresses spill prevention and control, spilled oil response and removal, and determination of liability and compensation for damage resulting from spills. The OCS onshore support facilities, including oil storage areas with tanks greater than 660 gallons, must have approved Spill Prevention Control and Countermeasure (SPCC) Plans prepared by the owners or operators of affected facilities. Guidelines for the preparation of these plans are provided by USEPA (40 CFR 112) and were established by Section 311(g)(1)(c) of the FWPCA. The USEPA is in the process of revising these regulations, and new draft regulations should be published in the first quarter of 1990.

Pursuant to Section 311(c)(2)(G) of the FWPCA and Section 105 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) is published and updated to provide for a coordinated and integrated response by agencies of the Federal Government to protect the environment from the damaging effects of pollution discharges. Revisions to the present NCP, codified on November 20, 1985 (40 CFR 300-399), were proposed in the *Federal Register* on December 21, 1988, in Vol. 50, No. 224, page 47912. The actual objectives of the NCP are to provide for efficient, coordinated, and effective action to minimize damage from oil and hazardous substances, including containment, dispersal, and removal. Provisions to accomplish these objectives include (1) assignment of duties and responsibilities among Federal agencies in coordination with State and local agencies; (2) identification, procurement, maintenance, and storage of equipment and supplies; (3) establishment or designation of a strike force to provide necessary services to carry out the plan and the establishment, at major ports, of trained and equipped emergency task forces; (4) a system of surveillance and reporting designed to ensure the earliest possible notice of discharges of oil to the appropriate Federal agency; (5) establishment of a national center to provide coordination and direction for operations in carrying out the NCP; (6) procedures and techniques to be employed in identifying, containing, dispersing, and removing oil; (7) a schedule, prepared in cooperation with the States, identifying dispersants and other chemicals, if any, that may be used in carrying out the NCP; (8) a system whereby the affected State(s) may be reimbursed for reasonable costs incurred in the removal of spills; (9) a procedure for coordinating scientific support of cleanup operations, assessment of damage after a spill, and research efforts; and (10) a system for referral and appeal of decisions of the Regional Response Teams and On-scene Coordinators (OSC's). The FWPCA establishes USEPA and USCG as enforcing agencies. These agencies have the authority to marshall the nation's capability to combat an oil spill and co-chair the Regional Response Teams established under the NCP. For spills in coastal and offshore waters, the USCG Captains-of-the-Ports serve as the OSC's. Section IV.C.6. discusses contingency planning in more detail.

The Clean Water Act also provides a comprehensive plan to limit and distribute liability for oil-spill costs. It authorizes the Federal Government to remove oil spilled from a vessel and to recover cleanup costs up to specified limits. Section I.B.3.b.(3)(d)(2) discusses the U.S. Coast Guard's Pollution Revolving Fund in more detail.

The Water Quality Act of 1987 expanded and strengthened the FWPCA (Clean Water Act) by building on progress already made in water quality and by addressing new and remaining problems. It focuses on these problems to restore and maintain our waters by structuring new programs and legislating these activities to achieve beneficial environmental results.

There are other important acts under which regulations have been promulgated to minimize pollution incidents and the potential environmental and economic damage caused by the release of pollutants from various sources to Gulf waters. These include the OCSLA, as amended; the Ports and Waterways Safety Act (Section I.B.4.a.); and CERCLA, or "Superfund," as amended by the Superfund Amendments and Reauthorizations Act of 1986 (SARA).

The National Estuary Program

In 1987 the National Estuary Program was established by an amendment, known as the Water Quality Act (P.L. 100-4, which, among other things, created Section 320), to the Clean Water Act. The purpose of the Program is to identify nationally significant estuaries, protect and improve their water quality, and enhance their living resources. Under the Program, which is administered by the USEPA, comprehensive management plans are generated to protect and enhance targeted estuaries. The governor of a state may nominate an estuary for the Program and request that a Comprehensive Conservation and Management Plan be developed for an estuary. Representatives from Federal, State, and interstate agencies, academic and scientific institutions, and industry and citizen groups work during a 5-year period to define objectives for protecting the estuary, to select the chief problems to be addressed in the Plan, and to ratify a pollution control and resource management strategy to meet each objective. Strong public support and subsequent political commitments are needed to accomplish the actions called for in the Plan, hence the 5-year time period to develop the strategies. A total of 17 estuaries have been selected for the Program, 4 of which are in the Gulf: Sarasota Bay and Tampa Bay in Florida, the Barataria-Terrebonne Estuarine Complex in Louisiana, and Galveston Bay in Texas. Brief descriptions of these four areas are given below.

Sarasota Bay is a small estuary on the southwest coast of Florida. Although generally regarded as a "clean" bay, it is threatened by overuse and growth pressure. Stormwater runoff and habitat loss have been identified as primary issues of concern in the restoration and enhancement of the estuary. Seven goals have been identified as targets upon which to focus the attention of all interested parties. Demonstration projects to begin the restoration of native, productive habitat to the bay system have been started, and these and others will be an integral part of the final comprehensive plan for the bay.

Tampa Bay is the largest open-water estuary in Florida and supports a myriad of uses, such as commercial and recreational fishing, shipping, sanitary and electrical services, waterfront development, tourism, and recreation. The water quality is good to excellent in much of the lower and middle Bay, declining in old Tampa Bay, and undesirable in the Hillsborough area. A number of causes of degradation have been identified, and goals have been established to improve the situation.

The Barataria-Terrebonne Estuarine Complex consists of an extensive array of estuarine wetlands and bodies of water containing more coastal wetlands than any other estuarine system in the United States. At least 19 percent of the nation's estuarine-dependent commercial fisheries is sustained by the Complex. It is also used for recreation by boaters, fishermen, and hunters, supporting important elements of the local economy and culture. As much as half of the national loss of coastal wetlands may have occurred in the Complex. Problems have been identified, and goals have been established to improve the situation.

The Galveston Bay system is the seventh largest estuary in the U.S. and the largest in Texas. The bay system provides 1,554 km^2 (600 mi^2) of very shallow water, averaging less than 3 m (10 ft) in depth. On the average, precipitation in the bay area watershed equals or exceeds what is lost through evaporation and nearly 10 million ac-ft of freshwater enter the bay annually. The resulting low salinity in the bay is the key to its productivity, providing ideal conditions for the growth of fish, crabs, shrimp, and oysters. In addition, the bay is surrounded by 526 km^2 (203 mi^2) of estuarine marsh, 36 km^2 (14 mi^2) of forested wetlands, and 158 km^2 (61 mi^2) of freshwater ponds and lakes. These ecological resources filter runoff to the bay system and provide rich source of nutrients that enhance biological productivity, as well as providing valuable habitat for many economically important species. The committees set up under the program will identify the critical issues facing Galveston Bay and then develop specific action plans and commitments to solve the problems identified.

j. U.S. Coast Guard--Safety and Pollution-Prevention Regulations

Section 4 of the OCSLA grants authority to USCG to promulgate and enforce regulations covering lighting and warning devices, safety equipment, and other safety-related matters pertaining to life and property on fixed OCS platforms and drilling vessels. Through the U.S. Coast Guard, DOT advises the Corps of Engineers on the issuance of permits and the placement of offshore structures.

33 CFR 154-157 and 159 describe pollution-prevention regulations and procedures for the transfer of oil from vessel to vessel (Part 156) and between onshore and offshore facilities and vessels (Part 154), for equipment and procedures to prevent oil pollution from vessels to the marine environment (Parts 155 and 157), and for the design and construction of marine sanitation devices (Part 159).

33 CFR 140-147 describe requirements for safety equipment and other matters relating to safety and for the promotion of life and property on the artificial islands and fixed structures located on the OCS, as established in Section 4(e)(1) of the OCSLA. New provisions under 33 CFR 146 were published. These provisions require emergency evacuation plans for OCS facilities, existing as of June 19, 1989, and including mobile offshore drilling units, be submitted to the Coast Guard before December 18, 1989. Furthermore, the Coast Guard is revising 33 CFR 140-147. Proposed regulations should be published during the first quarter of 1990.

46 CFR 107-109 describe regulations for the design, construction, inspection, and operation of mobile offshore drilling units. 33 CFR 149 prescribes requirements for pollution equipment that applies to each deep-water port.

New regulations for inspection and certification of new offshore supply vessels were published in the *Federal Register* on May 9, 1989 (Vol. 54, No. 88) and would consolidate 46 CFR 125-136, 170, and 174 for existing offshore supply-vessel standards. Specific rules are proposed for liftboats, which have experienced a high rate of casualties.

Most importantly, a new Memorandum of Understanding between MMS and USCG was published in the Federal Register on September 28, 1989 (Vol. 54, No. 187, pages 39820-29823) effective as of August 29, 1989. This memorandum aims to minimize duplication of effort and promote consistent, coordinated, and less burdensome regulation of OCS activities. Responsibilities are outlined for overseeing OCS facility design and construction, systems and equipment, and operations; for conducting inspections and investigations of accidents; and for review of oil spill contingency plans.

k. Executive Order 11990 (May 24, 1977), Protection of Wetlands

This Executive Order is pertinent to the proposed actions as it states in part:

> Each agency shall provide leadership and shall take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for: (1) acquiring, managing, and disposing of Federal lands and facilities; (2) providing federally undertaken, financed, or assisted construction and improvements; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

l. Executive Order 11988 (May 24, 1977), Floodplain Management

This Executive Order is pertinent to the proposed actions as it states in part:

> Each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities for (1) acquiring, managing, and disposing of Federal lands and facilities; (2) providing federally undertaken, financed, or assisted construction and improvements; and (3)

conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

m. Regulations for the Prevention of Pollution by Garbage from Ships

The Marine Pollution Research and Control Act of 1987 (Title II of Public Law 100-220) is a recent U.S. law implementing Annex V of the International Convention for the Prevention of Pollution from Ships. Most of the law's regulatory provisions became effective on December 31, 1988. Under provisions of the new law, all ships and watercraft, including all commercial and recreational fishing vessels, are prohibited from dumping plastics at sea. The law also severely restricts the legality of dumping other vessel-generated garbage and solid waste items both at sea and in U.S. navigable waters. The USCG will enforce the provisions of this law and has developed interim rules for its implementation (54 FR 81, April 28, 1989) calling for adequate trash reception facilities at all ports, docks, marinas, and boat launching facilities.

Interim final rules published May 2, 1990 (55 FR 85, pages 18578-18581), explicitly state that fixed and floating platforms or all drilling rigs, manned production platforms, and support vessels operating under a Federal oil and gas lease are required to develop Waste Management Plans (33 CFR 151.57) and to post placards reflecting MARPOL, Annex V dumping restrictions (33 CFR 151.59). Waste Management Plans will require oil and gas operators to describe procedures for collecting, processing, storing, and discharging garbage; and to designate the person who is in charge of carrying out the plan. These rules also apply to all oceangoing ships of 40 ft or more in length that are documented under the laws of the U.S. or numbered by a state and that are with a galley and berthing. Placards noting discharge limitations and restrictions, as well as penalties for noncompliance, apply to all boats and ships 26 ft or more in length. Furthermore, the Shore Protection Act of 1988 (FR 22546; May 24, 1989) requires ships transporting garbage and refuse to assure that it is properly contained on board so it will not be lost in the water from inclement wind or water conditions.

n. National Marine Sanctuaries and National Estuarine-Research Reserves

The National Marine Sanctuary and National Estuarine-Research Reserve programs are administered by the Marine and Estuarine Management Division, National Ocean Service, National Oceanic and Atmospheric Administration of the U.S. Department of Commerce. The marine-sanctuary program was established by the Marine Protection, Research, and Sanctuaries Act of 1972 (33 U.S.C. 1401-1445), and the estuarine-research reserve program by the Coastal Zone Management Act of 1972.

Marine sanctuaries and estuarine-research reserves are designed and managed to meet the following goals, among others:

(1) enhance resource protection through the implementation of a comprehensive, long-term management plan tailored to the specific resources;

(2) promote and coordinate research to expand scientific knowledge of significant marine resources and improve management decisionmaking;

(3) enhance public awareness, understanding, and wise use of the marine environment through public interpretive and recreational programs; and

(4) provide for optimum compatible public and private use of special marine areas.

Marine Sanctuaries

Title III of the Marine Protection and Sanctuaries Act pertains to national marine sanctuaries. Only sites with special marine or historical resources are selected for marine sanctuary status. Sites selected for consideration are evaluated on the merits of resource and human-use values and on the public benefits to be derived from sanctuary status.

No marine sanctuaries have been established in the Gulf of Mexico; however, two are located on the Atlantic side of the Florida Keys: Looe Key National Marine Sanctuary and Key Largo National Marine Sanctuary.

One site is well along the road to sanctuary designation. The Flower Garden Banks were named an Active Candidate for designation as a national marine sanctuary (49 FR 30988-30991) on August 2, 1984. Selection of the site as an Active Candidate formally triggers the National Environmental Policy Act process. The NOAA prepared a draft management plan and a draft EIS in February 1989; proposed regulations were published in the *Federal Register* on February 24, 1989 (54 FR 7953). Designation of the sanctuary may take place in late 1990. This site, located 177 km (110 mi) offshore, represents the northernmost coral reef community in the Western Gulf of Mexico. The proposed borders of the sanctuary encompass a total of 114 km^2 (44 mi^2). The area is a valuable representation of a tropical coral reef community dominated by hermatypic coral (*Montastrea annularis*, *M. cavernosa*, *Porites asteroides*, and *Diploria strigosa*) and associated reef fishes and invertebrates. The DOI has protected the biological resources of the Flower Garden Banks from possible damage due to oil and gas exploration and development activities by the establishment of a "No Activity Zone" and by operational restrictions as described in the Topographic-features Stipulation proposed for Sale 135 (Section II.B.1.c.(1)). The DOI cannot, however, protect these reefs from damage due to activities outside DOI's permitting process. The Gulf of Mexico Fishery Management Council, in its proposed FMP for corals, has designated the area within the 50-fathom (91.4-m) isobath at the Flower Garden Banks as a Habitat Area of Particular Concern (HAPC) (50 CFR 638), but even with such designation the Council may be unable to regulate "nonfishing" activities such as anchoring of ships. The MMS, therefore, supports designation of the reefs as a marine sanctuary in order to protect the reefs from non-oil- and gas-related activities, such as anchoring (which has been shown to be the most destructive of man's activities in the area), the use of heavy trawls (such as roller trawls), and the taking of corals and reef fishes. In announcing the availability of the Draft EIS, NOAA stated that "Existing regulatory authorities in the proposed sanctuary . . . will be unaffected by sanctuary designation. . ." However, the following activities may be regulated by NOAA under the terms of designation:

(1) anchoring by vessels (initially, only vessels greater than 100 ft in registered length would be prohibited from anchoring in the sanctuary);

(2) depositing or discharging of materials or substances;

(3) altering the seabed except in the conduct of hydrocarbon exploration and development in sanctuary areas lying outside of the no-activity zones established by DOI;

(4) removing or injuring coral or other resources;

(5) using fishing gear other than conventional hook and line gear; and

(6) detonating explosives or releasing electrical charges.

Two sites in the Florida Keys are being studied for possible inclusion in the marine-sanctuary program: Sombrero Key and Alligator Reef. An initial study to identify habitats and to determine impacts from human use is being conducted. At the completion of the study, public workshops will be conducted, and if the two sites meet the criteria for sanctuaries, the designation process will be set in motion.

Three additional sites in the Gulf are on the Site Evaluation List (SEL), which potentially leads to an area being designated as an Active Candidate. These are Shoalwater Bay--Chandeleur Sound (Louisiana), the Big Bend Seagrass Beds off Florida, and Baffin Bay (Texas). Areas on the SEL are given additional study for potential designation as an Active Candidate; such designation will then result in even further evaluation for possible designation as a National Marine Sanctuary. No schedule has been established for these studies and possible designations.

Estuarine-Research Reserves

Three estuarine-research reserves have been established in the Gulf of Mexico: Rookery Bay National Estuarine Research Reserve and Apalachicola National Estuarine Research Reserve in Florida, and Weeks Bay National Estuarine Research Reserve in Alabama.

Rookery Bay National Estuarine Research Reserve, at more than 3,440 ha (8,500 ac), preserves a large mangrove-filled bay and two creeks, along with their drainage corridors, from Florida's ever-expanding land development. Management of the sanctuary is by the Florida Department of Natural Resources, the Collier County Conservancy, and the National Audubon Society. This unique management structure was created when the two private organizations granted a dollar-per-year, 99-year lease of the land to the State. Federal and State funds will add additional key acreage to the existing core area. The diversity of the area's fauna can be recognized by the porpoises that feed there and the bald eagles and whitetailed deer that make Rookery Bay their permanent residence. Within the Sanctuary is the Rookery Bay Marine Laboratory, which, even before the establishment of the sanctuary, provided data used in important coastal management decisions---a primary objective of Congress in establishing the estuarine research-reserve program.

At more than 76,890 ha (190,000 ac), the Apalachicola National Estuarine Research Reserve is one of the largest remaining naturally functioning ecosystems in the nation, and it is also the first sanctuary on the mouth of a major navigable river. Because of this, its establishment served to promote improved cooperation concerning river navigation among the States of Florida, Alabama, and Georgia. The major business activity of Apalachicola, which is adjacent to the sanctuary, centers around the oyster industry, and it is expected that the sanctuary will benefit this and other fishing industries by protecting the environment and by providing research information that will help assure the continued productivity of the bay/river ecosystem. A USFWS refuge and a State park, which represents a unique cooperative effort at ecosystem protection, exists with the boundaries of the reserve.

Weeks Bay National Estuarine Research Reserve constitutes a small estuary of approximately 810 ha (2,000 ac), comprising open shallow waters with an average depth of less than 1.5 m (5 ft) and extensive vegetated wetlands areas. It receives waters from the spring-fed Fish and Magnolia Rivers and connects through a narrow opening with Mobile Bay, the principal element of coastal Alabama.

There are no additional sites proposed as National Estuarine Research Reserves in the Gulf of Mexico.

Title I of the Marine Protection, Research, and Sanctuaries Act is administered by USEPA. Section 102 of the Act provides that USEPA may issue permits, after public notices and hearings, for the transportation of material for the purpose of dumping into ocean waters, after a determination that such dumping will not unreasonably degrade or endanger human health, welfare, or the marine environment.

o. Ocean Dumping

All ocean dumping is regulated by the Marine Protection, Research, and Sanctuaries Act of 1972, as amended (33 U.S.C. 1401 et seq.). Regulations (40 CFR 220 et seq.) implementing the Act require a USEPA permit for all ocean dumping of industrial wastes and municipal sludge materials. The termination of ocean dumping of sewage sludge and industrial wastes by December 31, 1981, was mandated by 33 U.S.C. 1412a. The designated ocean areas where wastes may be disposed are listed in 40 CFR 228. Further, USEPA has published an annual report entitled Ocean Dumping in the United States. This report includes information on permit holders, types of waste approved for disposal under the permit, and yearly waste volumes disposed. The USEPA has one designated deep-water disposal area in the Gulf of Mexico, as shown on Visual No. 3. The site is designated for the incineration of hazardous wastes, should any such permits be issued in the future; there are no active incineration permits and none are proposed. The entire incineration program may be considered inactive at the present time.

The current interim-designated Dredged Material Disposal Sites are now being converted by the USEPA into formally-designated sites. These sites, used for the disposal of dredged material from the U.S. Army Corps of Engineers channel dredging programs, have, in most cases, been used for this purpose for as long as 25 years. See Section IV.B.4.a. for a discussion of the impacts of these activities.

p. Clean Air Act

The Clean Air Act (CAA) (42 U.S.C. 7401-7642), as amended, authorizes the USEPA to provide for air-pollution prevention and control: specifically, (a) to protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population; (b) to initiate and accelerate a national research and development program to achieve the presentation and control of air pollution; (c) to provide technical and financial assistance to State and local governments in connection with development and execution of their air-pollution prevention and control programs; and (d) to encourage and assist the development and operation of regional air pollution control programs.

The Act authorizes USEPA to establish national/primary ambient air-quality standards and regulations for implementing enforcement of these primary standards within air-quality control regions of each State, as well as NAAQS for hazardous air pollutants.

The Act requires that the Federal departments or agencies having jurisdiction over any property or facility or engaged in any activity resulting in the discharge of air pollutants comply with all Federal, State, interstate, and local requirements in the control and abatement of air pollution. The Act is referred to in Section 5(a)(8) of the OCSLA, which prescribes DOI's authority to regulate air emissions from OCS oil and gas facilities.

5. Gulf of Mexico Regional Environmental Studies Program

The MMS supports and administers a large, multidisciplinary studies program to develop information needed for assessment and mitigation of impacts to human, marine, and coastal environments that may be affected by OCS oil and gas activities. This program was initiated in 1973 by the Bureau of Land Management (BLM), which then had responsibility for OCS leasing. Since program initiation, more than 140 studies projects, at a cumulative funding level in excess of $75 million, have been awarded to support leasing and regulatory functions of the Minerals Management Service's OCS Program within the Gulf of Mexico OCS Region.

The MMS Environmental Studies Program (ESP) is authorized by the OCS Lands Act Amendments of 1978. Section 20 of the Act mandates the program and provides three general goals: (a) to establish information needed for assessment and management of environmental impacts on the human, marine, and coastal environments of the OCS and the potentially affected coastal areas; (b) to predict impacts on the marine biota, which may result from chronic low-level pollution or large spills associated with OCS production, from muds and cuttings discharges, pipeline emplacement, and impacts of onshore development; and (c) to monitor human, marine, and coastal environments to provide time-series and data-trend information for identification of significant changes in the quality and productivity of these environments, for detection of change trends, and for identification of the causes of these changes.

Appendix E provides detailed information on the history and accomplishments of the ESP as well as a discussion of how the program is administered.

SECTION II

ALTERNATIVES INCLUDING THE PROPOSED ACTIONS

II. ALTERNATIVES INCLUDING THE PROPOSED ACTIONS

A. PROPOSED CENTRAL GULF SALE 131

1. Alternative A - The Proposed Action

a. Description

Proposed Central Gulf Sale 131 is scheduled to be held in March 1991 and will offer approximately 5,204 unleased blocks (as of June 1990) comprising about 28.1 million acres in the CPA. The actual number of blocks offered for lease will differ from this figure by the number of blocks relinquished, canceled, and terminated. The sale area includes acreage located from 4.8 to 354 km offshore in water depths ranging from 4 to 3,425 m. There are no areas deferred from the CPA, but there are alternatives to the proposed action and protective mitigating measures available for adoption. The alternatives are to delete biologically sensitive areas near topographic features or to take no action (cancel the sale). The potential mitigating measures are protection of biological resources (topographic features and live bottoms), protection of archaeological resources, and mitigation of conflicts with military activities.

The analyses of impacts summarized below (Section II.A.1.b.) and described in detail in Section IV.D.1.a. are based on a development scenario (Base Case) formulated to provide a set of assumptions and estimates on the amounts, locations, and timing for OCS exploration, development, and production operations and facilities, both offshore and onshore. These are estimates only and not predictions of what will happen as a result of holding this proposed sale. Tables IV-1, IV-4, and IV-8 through IV-10 summarize major elements of the development scenario and related impact-producing factors for the proposed action. A detailed discussion of the development scenario and major related impact-producing factors is included in Section IV.A. The following major assumptions and estimates are included in the Base Case.

- The discovery and production of 0.13 billion bbl of oil (BBO) and 1.21 trillion cubic feet (tcf) of gas during the period 1993-2024.

- The drilling of 310 exploration and delineation wells during the period 1992-2002.

- The installation of 25 production platforms and the drilling of 230 development wells during the period 1993-2018.

- Oil and gas production beginning in 1993 and reaching peak annual production during the period 2006-2007 for oil (6.4 MMbbl/year) and during the year 2007 for gas (58.2 bcf/year).

- Estimated drilling mud solid discharges of 2.46 million barrels (MMbbl); estimated drill cutting discharges of 0.276 million cubic yards; and produced water discharges of 413 MMbbl onshore and 703 MMbbl offshore.

- All economic gas production and most oil production (96.7%) will be transported by pipeline to onshore gas processing facilities and oil terminals in the Central coastal area. Some oil production (0.3%) will be transported via about 3 shuttle tanker trips to existing port/terminal facilities in the Central coastal area. The remaining oil production (about 3%) will be barged to shore locations. Oil at the terminals will then move via the existing pipeline, barging, or trucking network to refineries located within the Gulf coastal zone.

- The construction of 201 km of offshore pipeline (gathering and mainline).

- The occurrence of one oil spill of about 6,500 bbl.

- Onshore support and processing are expected to be provided entirely from facilities (primarily in the Central and Western coastal areas) existing prior to the proposed action or from facilities established/constructed subsequent to the proposed action as a result of cumulative oil and gas activity (Federal OCS and other) occurring subsequent to the proposed action. No major facility construction is expected to occur solely as a result of the proposed action.

b. Summary of Impacts

The following are summaries of the detailed impact analyses that are included in Section IV.D.1.a. It is noted that these summaries are limited to the impact of the proposed action alone (under the Base Case); the cumulative impacts, which are assessed in Section IV.D.1.a., are not summarized here. Table S-3 indicates the level of impact on each resource category estimated as a result of the cumulative factors.

Five levels of impact are defined for each impact topic and used in the conclusion to indicate the degree of intensity or severity of the impact judged from the analysis. The five levels are designated by the following qualitative terms indicating the degree of impact: very high; high; moderate; low; and very low. Definitions of these impact levels for each resource category are provided in Table S-6.

To facilitate the analysis, the Federal offshore area is divided into subplanning areas. The CPA is comprised of four subplanning areas (C-1, C-2, C-3, and C-4) and the coastal region is divided into four coastal subareas (C-1, C-2, C-3, and C-4). These subareas are delineated on Figure IV-1.

(1) Impacts on Sensitive Coastal Habitats

(a) Coastal Barriers

Several impact-producing factors may threaten barrier landforms.

Oil spill clean up operations could result in the removal of large quantities of oiled sand. Sand removal could result in accelerated erosion, particularly along the sediment-starved barriers that characterize the Louisiana coast. Because of the very low probability of occurrence and contact from either an offshore (platform blowouts, shuttle tanker accidents, or pipeline accidents) or onshore spill (shuttle tanker or barge spills or pipeline accidents), however, it is assumed that no contact from a spill will occur. Furthermore, clean up methods could be used that do not result in the removal of beach sand. The impact level from this factor is considered to be very low.

Impacts from onshore and nearshore construction of OCS-related infrastructure (pipeline landfalls, service bases, platform yards, etc.) are not expected to occur because no new infrastructure construction is anticipated as a result of the proposed action. The impact level from this factor is considered to be very low.

No new navigation channels are anticipated as a result of the proposed action. Maintenance dredging of existing canals through barrier passes to accommodate vessel traffic to support the proposed action could alter littoral dynamics in the vicinity of the channel and affect erosion and deposition patterns. Field studies, however, have not substantiated that dredging has resulted in coastal barrier erosion. The impact level from this factor is considered to be very low.

It follows from the above that activities resulting from the proposed action will not have a significant impact on coastal barriers.

Conclusion

Impacts of the proposed action on coastal barriers in the CPA are expected to be very low.

(b) Wetlands

Several impact-producing factors may threaten coastal wetlands.

Oil spills that contact wetlands can result in the die back of aboveground vegetation and complete plant mortality if high concentrations of oil persist in the soil. Wetlands in which vegetation has been killed and weakened by contact with oil will be subject to accelerated shore erosion while the vegetation is recovering.

Large oil spills that occur as a result of the proposed action are not assumed to contact coastal wetlands in the CPA, however. The occurrence and contact from a few spills less than 50 bbl and greater than 1 bbl will not affect marsh vegetation because of the low concentrations of oil that will contact the wetlands.

Dredging of pipeline and navigation canals has both direct and indirect impacts on coastal wetlands. Also, the construction of OCS-related onshore support facilities, such as pipe yards and service bases, in wetland areas results in the conversion of wetland habitat to commercial land. No new dredging for pipeline or navigation canals and no new onshore infrastructure construction, however, are anticipated in CPA wetlands as a result of the proposed action. Maintenance dredging in existing navigation channels could adversely affect wetlands if the dredge material were disposed of in continuous spoil banks. Alternative methods of dredge disposal, however, can be used to minimize wetlands impacts. Furthermore, the contribution of the proposed action to the total navigational usage of channels in the CPA is very small. Accelerated erosion of navigation channels into wetland areas from OCS vessel traffic will result in only an estimated 6 ha of accelerated erosion as a result of the Base Case scenario.

Field studies have shown that the discharge of OCS produced waters into coastal water bodies has no impact on nearby wetlands because produced waters are almost always discharged into canals with spoil banks which confine the waters to the canal itself. The impact level from this factor is expected to be very low.

It follows from the above that activities associated with the proposed action will result in very low impacts to coastal wetlands.

Conclusion

The level of impact on coastal wetlands is expected to be very low.

(2) Impacts on Sensitive Offshore Habitats and Communities

(a) Live Bottoms (Pinnacle Trend)

Activities resulting from the proposed action, particularly anchor damage to localized pinnacle areas, are expected to have a high level of impact on some individuals at portions of the pinnacle trend environment, since these activities have the potential to destroy some of the biological communities and damage one or several individual pinnacles. However, the impact to the pinnacle trend area as a whole is expected to be slight because no community-wide impacts are expected. The range of impacts that may potentially affect the pinnacle region is low to very low. The most potentially damaging of these are the impacts associated with mechanical damages that may result from anchors. However, the action is judged to be infrequent because of the limited operations in the vicinity of the pinnacles and the small size of many of the features. Potential impact levels from large oil spills, blowouts, pipeline emplacement, muds and cuttings discharges, and structure removals are very low. The frequency of impacts to the pinnacles is rare, and the severity is judged to be slight because of the widespread nature of the features. The impact of these activities on the pinnacle region as a whole is low.

Conclusion

The impact of the Base Case of the proposed action on the pinnacle trend region is expected to be low.

(b) Deep-water Benthic Communities

The only impact-producing factor threatening the chemosynthetic communities is physical disturbance of the bottom, which would destroy the organisms comprising these communities. Such disturbance would come from those OCS-related activities associated with pipelaying, anchoring, structure emplacement, and seafloor blowouts. Only structure emplacement is considered to be a threat, and then only to the high-density (Bush Hill-type) communities; the widely distributed low-density communities would not be at risk. The provisions of NTL 88-11 (currently in effect), requiring surveys and avoidance prior to drilling, will reduce, but not completely eliminate, the risk.

Conclusion

The level of impact on the localized deep-water benthic communities of the Bush Hill type in the Central Gulf resulting from the proposed action is expected to be moderate. The impact to the widespread low-diversity areas is expected to be low.

(c) Topographic Features

Several impact-producing factors may threaten the communities of the topographic features.

Anchoring of vessels and structure emplacement result in physical disturbance of the benthic environment and are the most likely activities to cause permanent or long-lasting impacts to sensitive offshore habitats. Recovery from damage caused by such activities may take 10 or more years. The impact level from this factor is considered to be very high.

Operational discharges (drilling muds and cuttings, produced waters) may impact the biota of the banks due to turbidity and sedimentation, resulting in death to benthic organisms in large areas. Recovery from such damage may take 10 or more years. The impact level from this factor is considered to be very high.

Blowouts may similarly cause damage to benthic biota by resuspending sediments, causing turbidity and sedimentation, and resulting in death to benthic organisms. Recovery from such damage may take up to 10 years. Fortunately, blowouts are rare in the Gulf. The impact level from this factor is considered to be low.

Oil spills (there is an estimated 16% chance of an oil spill greater than or equal to 1,000 bbl occurring in the Central Gulf as a result of this proposed action) will cause damage to benthic organisms if the oil contacts the organisms; such contact is likely only from spills from blowouts, which are rare in the Gulf. The impact level from this factor is considered to be very low.

Structure removal using explosives (as is generally the case) results in water turbidity, sediment deposition, and potential explosive shock-wave impacts. Severe damage to benthic organisms could result. Recovery from such damage could take more than 10 years. The impact level from this factor is considered to be high.

It follows from the above that activities resulting from this proposal, especially bottom-disturbing activities, have a potential for causing very high impacts to the biota of the topographic features. While some of the activities are expected to result in lower impacts, those having the greatest impacts are also those most likely to occur.

Conclusion

The proposed action is expected to have a very high impact on the sensitive offshore habitats of the topographic features.

(3) Impacts on Water Quality

(a) Coastal and Nearshore

All existing onshore infrastructure and associated coastal activities occurring in support of Sale 131 will contribute to the degradation of regional coastal and nearshore water quality to a low extent because each provides a low measure of continuous contamination and because discharge locations are widespread, particularly in the Mississippi Deltaic area of Louisiana. Discharges or actions affecting coastal and nearshore waters include the following types. Process, cooling, boiler, and sewage water effluents will be discharged due to the 2 percent use of the existing 46 gas processing plants, 18 oil refineries, 10 pipe yards, 24 service bases, 80 terminals, and 53 separation facilities in support of Sale 131. These effluents, occurring in connection with Sale 131, will result in somewhat less than a 1 percent loss of water usage in the State of Louisiana and less in other states. There are only 13 facilities located outside Louisiana, these are located in Mississippi and Alabama. Four hundred and thirteen million bbl of OCS produced-water discharges will have high localized impacts at 11 locations along the Louisiana shoreline. The Mississippi Delta area will receive the greatest amount of these discharges. Negligible saltwater intrusion would occur from maintenance dredging of existing navigation channels and deepening of others for large vessel requirements, except in the Deltaic Plain area, where maintenance dredging is expected to take place every one or two years. Such dredging will result in short-term, low-level impacts to the surrounding waters. The three shuttle-tanker trips and 15,000 service vessel trips are likely to further impact water quality by routine release of bilge and ballast waters (estimated at 2,000 liters per day from service vessels), chronic fuel and tank spills, trash, and low-level releases of the contaminants in antifouling paints. A few oil spills greater than 50 bbl and less than 1,000 bbl will contribute to a low-level impact locally near some terminals and service bases where the spills have a probability of occurrence; regionally, impacts from such oil spills will be very low.

The ability of water to assimilate through dilution and biochemical processes is often stressed when there is more than one source or type of contamination. Contamination can be additive so that the level of impact from several concurrent sources is greater than any one source. When examining all of the discharges together, impacts on coastal water quality from OCS oil and gas operations associated with the proposed action will be moderate in the lower Mississippi Delta area, which will be impacted due to high support-vessel traffic and concentrated infrastructure, and will be very high in 11 locations along the coast due to large amounts of produced waters discharged into these areas (seven of these areas are in the Mississippi Delta area). In particular, the areas along the lower Mississippi River, near Venice and Grand Isle, Louisiana, and around Morgan City, Louisiana, will experience moderate or very high impacts. Regionally, chronic, long-term degradation of water quality is estimated to occur at a low level as a result of the proposed action.

Conclusion

Impacts from OCS oil and gas operations associated with the proposed action on coastal water quality are estimated to be moderate in the lower Mississippi Delta area. Regionally, chronic, long-term degradation of water quality is estimated to occur at a low level.

(b) Offshore

Several impact-producing factors may adversely affect offshore water quality.

Resuspension of bottom sediments may result from drilling operations, platform and pipeline installation, and platform removal operations. Some measures of water quality parameters may change from background levels with little effect to the users of the water, and then only very close to the source. The impact level from this factor is considered to be low.

Operational discharges (drilling muds and cuttings, produced waters, deck drainage, and sanitary and domestic wastes) may degrade some measures of water quality, changing them from background levels, but with little effect to the users of the water, and then only very close to the source. The impact level from this factor is considered to be low.

Accidental oil spills (there is an estimated 16% chance of an oil spill greater than or equal to 1,000 bbl occurring in the Central Gulf as a result of this proposed action) may degrade some measures of water quality, changing them from background levels, but with little effect to the users of the water, and then only in a very limited area close to the source. The impact level from this factor is considered to be low.

Activities resulting from this proposal all result in low impacts limited to very close to the source.

Conclusion

As a result of the proposed action, the impact to offshore water quality in the Central Gulf is estimated to be low.

(4) Impacts on Air Quality

Air quality degradation may occur from onshore and offshore operational emissions as a result of drilling, production, and processing. Short-term degradation of air quality due to evaporation could occur as a result of a large oil spill; however, this impact would be localized geographically and would disperse rapidly in time, making the environmental effects negligible. Of the coastal parishes/counties adjacent to the majority of offshore development, the ones most likely to be adversely impacted by new activity due to their unique statusas non-attainment or being PSD Class I areas are Orleans, Jefferson, St. Bernard, St. Charles, Lafourche, St. Mary, and Plaquemines Parishes, Louisiana. The expected levels of new activities adjacent to these parishes are not expected to be large due to trends in leasing farther offshore. This trend toward development farther offshore will increase distances to shore, which will result in a greater dispersion of emissions, that is, a very low level of impact. Oil and gas activities on the OCS are not expected to occur simultaneously and are not expected to cause impacts above the level defined as very low for the planning area. A summary of expected impacts on the air resource is presented in Table IV-31.

Conclusion

Impacts on St. Bernard, Plaquemines, St. Mary, Lafourche, St. Charles, Jefferson, and Orleans Parishes in Louisiana are estimated to be moderate. Very low impacts are expected to occur throughout the remainder of the coastal area of the Central Gulf.

(5) Impacts on Endangered and Threatened Species

(a) Kemp's Ridley Sea Turtle

Several impact-producing factors may have adverse impacts on the Kemp's ridley sea turtle.

Anchoring, pipe and structure emplacement, dredging, produced waters, domestic-sanitary waste, and some oil-spill impacts result in disturbance of the seagrasses and benthic fauna utilized by sea turtles. Recovery from damage caused by such activities would take six months to two years. The impact level from this factor is considered low.

The removal of oil and gas structures with explosives could result in shock-wave-related injuries. Sea turtles may be affected several times during the lease. Recovery from such damage could take one generation. The impact level from this factor is considered low.

Vessel traffic associated with the proposed action could collide with or displace sea turtles. Such interactions could cause or be indirectly related to turtle mortality. These interactions are estimated to occur several times during the lease life. Recovery could be accomplished in one generation. The impact level from this factor is considered low.

The entrapment in or ingestion of trash and debris that is generated as a result of the proposed action could cause the drowning or starvation of sea turtles. These interactions are estimated to occur several times during the lease life and result in losses that would require one generation to recover. The impact level from this factor is considered low.

Contact with, ingestion of, or displacement by spilled oil resulting from the proposed action will have adverse impacts on sea turtles. Turtle/oil spill interactions are estimated to be unlikely but could result in population losses that would require three or more generations to recover. The impact from this factor is considered moderate.

While the level of impact from the sale-related activities varies, those activities having the greatest impact most accurately represent the effect of the sale on the species because of its limited ability to sustain its population and recover from adverse impacts.

Conclusion

The impact of the Base Case on the Kemp's ridley sea turtle is estimated to be moderate.

(b) Loggerhead Sea Turtle

Several impact-producing factors may have adverse impacts on the loggerhead sea turtle.

Anchoring, pipe and structure emplacement, dredging, produced waters, domestic-sanitary waste, and some oil-spill impacts result in disturbance of the seagrasses and benthic fauna utilized by sea turtles. Recovery from damage caused by such activities would take six months to two years. The impact level from this factor is considered low.

The removal of oil and gas structures with explosives could result in shock-wave-related injuries or displacement from preferred habitats. Sea turtles may be affected several times during the lease. Recovery from such damage could take one generation. The impact level from this factor is considered low.

Vessel traffic associated with the proposed action could collide with or displace sea turtles. Such interactions could cause or be indirectly related to turtle mortality. These interactions are estimated to occur several times during the lease life. Recovery could be accomplished in one generation. The impact level from this factor is considered low.

The entrapment in or ingestion of trash and debris that is generated as a result of the proposed action could cause the drowning or starvation of sea turtles. These interactions are estimated to occur several times during the lease life and result in losses that would require one generation to recover. The impact level from this factor is considered low.

Contact with, ingestion of, or displacement by spilled oil resulting from the proposed action will have adverse impacts on sea turtles. Turtle/oil spill interactions are estimated to be unlikely but could result in losses that would require one to two generations to recover. The impact from this factor is considered low.

While the level of impact from the sale-related activities varies, those activities having the greatest impact most accurately represent the effect of the sale on the species because of its limited ability to sustain its population and recover from adverse impacts.

Conclusion

The impact of the Base Case on the loggerhead sea turtle is estimated to be low.

(c) Great Whales

Several impact-producing factors may have adverse impacts on the great whales.

Operational discharges (drilling muds and cuttings) may reduce the whales' food sources by death or displacement resulting from sedimentation, turbidity, or ingestion. Such impacts are unlikely to occur and are primarily sublethal. The impact level of this factor is considered very low.

Vessel traffic associated with the proposed action could collide with or displace whales. Such interactions could cause or be indirectly related to mortality. These interactions are estimated to occur once during the lease life. Recovery could be accomplished in less than one generation. The impact level from this factor is considered very low.

The removal of oil and gas structures with explosives could result in shock-wave-related injuries or displacement from preferred habitats. Whales may be affected once during the lease. Recovery from such damage could take one generation. The impact level from this factor is considered very low.

Explosions during seismic exploration could result in shock-wave-related injuries or displacement from preferred habitats. Whales may be affected several times during the lease. Recovery from such damage could take less than one generation. The impact level from this factor is considered low.

Contact with, ingestion of, or displacement by spilled oil resulting from the proposed action will have adverse impacts on whales. Interactions between oil and whale habitat may occur several times during the lease life, and any resultant declines would be recoverable in one generation. The impact from this factor is considered low.

While the level of impact from the sale related activities varies, those activities having the greatest impact most accurately represent the effect of the sale on the species because of its limited ability to sustain its population and recover from adverse impacts.

Conclusion

The impact of the proposed action on great whales is estimated to be low.

(d) Piping Plover

Several impact-producing factors may have adverse impacts on the piping plover.

Pipeline landfalls and onshore construction that may arise as a result of the proposed action may contribute to piping plover mortality by habitat destruction or displacement from preferred habitats. Such impacts are primarily sublethal and are estimated to occur once during the lease life. The impact level from this factor is considered very low.

Contact with, ingestion of, or displacement by spilled oil resulting from the proposed action will have adverse impacts on piping plovers. Interactions between piping plovers and spilled oil are estimated to occur once during the lease life, and resultant population losses would recover within one generation. The impact from this factor is considered low.

While the level of impacts from the sale-related activities varies, those activities having the greatest impacts most accurately represent the effect of the sale on the species because of its limited ability to sustain its population and recover from adverse impacts.

Conclusion

The proposed sale is estimated to have a low impact on the piping plover.

(e) Brown Pelican

Several impact-producing factors may have adverse impacts on the brown pelican.

Pipeline landfalls and onshore construction that may arise as a result of the proposed action may contribute to brown pelican mortality by habitat destruction or displacement from preferred habitats. Such impacts are primarily sublethal and are estimated to occur once during the lease life. The impact level from this factor are considered very low.

Contact with, ingestion of, or displacement by spilled oil resulting from the proposed action will have adverse impacts on brown pelicans. Interactions between brown pelicans and spilled oil are estimated to occur once during the lease life, and resultant population losses would require one to two generations to recover. The impact from this factor is considered low.

Disturbance by sale-related air traffic could alter the normal behavior of brown pelicans or encourage the abandonment of otherwise preferred habitat. These interactions could occur annually, but any mortality would probably recover in less than one generation. The impact from this factor is considered low.

The entrapment in or ingestion of trash and debris that is generated as a result of the proposed action could cause the drowning or starvation of brown pelicans. These interactions are estimated to occur several times during the lease life and result in losses that would require one generation to recover. The impact level from this factor is considered low.

While the level of impacts from the sale-related activities varies, those activities having the greatest impacts most accurately represent the effect of the sale on the species because of its limited ability to sustain its population and recover from adverse impacts.

Conclusion

The impact of the proposed sale on brown pelicans is estimated to be low.

(f) Gulf Sturgeon

Operational discharges (drilling muds and cuttings) may reduce the Gulf sturgeons' food sources by death or displacement resulting from sedimentation, turbidity, or ingestion. Such interactions could occur once during the lease life and could result in a population decline that would take one to two generations to recover. The impact level of this factor is considered low.

While the level of impacts from the sale-related activities varies, those activities having the greatest impacts most accurately represent the effect of the sale on the species because of its limited ability to sustain its population and recover from adverse impacts.

Conclusion

The impact of the Base Case scenario on the Gulf sturgeon is estimated to be low.

(6) Impacts on Marine Mammals

Several impact-producing factors may have adverse impacts on the marine mammals.

Operational discharges (drilling muds and cuttings) may reduce the marine mammals' food sources by death or displacement resulting from sedimentation, turbidity, or ingestion. Such impacts are unlikely to occur and are primarily sublethal. The impact level of this factor is considered very low.

Vessel traffic associated with the proposed action could collide with or displace marine mammals. Such interactions could cause or be indirectly related to mortality. These interactions are estimated to occur once during the lease life. Recovery could be accomplished in less than one generation. The impact level from this factor is considered very low.

The removal of oil and gas structures with explosives and seismic exploration could result in shock-wave-related injuries. Marine mammals may be affected several times during the lease. Recovery from such damage could take less than one generation. The impact level from this factor is considered low.

Contact with, ingestion of, or displacement by spilled oil resulting from the proposed action will have adverse impacts on marine mammals. Interactions between oil and marine mammal habitat may occur several times during the lease life, and any resultant declines would be recoverable in one generation. The impact from this factor is considered low.

While the level of impacts from the sale-related activities varies, those activities having the greatest impacts most accurately represent the effect of the sale on the species because of its limited ability to sustain its population and recover from adverse impacts.

Conclusion

The impact of the proposed sale on marine mammals is estimated to be low.

(7) Impacts on Coastal and Marine Birds

Several impact-producing factors may threaten coastal and marine birds.

The OCS-related helicopter and service-vessel traffic results in displacement of birds from nesting and feeding habitats. A maximum of 1,000 service-vessel trips and 1 shuttle-tanker trip will occur per year through existing port areas. At worst, the effect of vessel or air traffic during any time of year is of a very short-term nature. The MMS regulates flight elevation to no lower than 2,000 ft during the time of year of greatest concentration of coastal and marine birds (mid-October to mid-April). The impact level from this factor is considered to be very low.

Pipeline landfalls and coastal facility construction result in possible desertion of birds from nesting and feeding habitats. No new OCS-related pipeline landfalls or coastal construction are projected for the proposed action. The impact level from this factor is considered to be very low.

Entanglement or ingestion of OCS-related plastic debris may injure or kill coastal and marine birds. The MMS prohibits the disposal into offshore waters of any OCS-related materials, including plastics. In addition, MARPOL, Annex V, prohibits the disposals of any plastics at sea or in coastal waters. The impact level from this factor is considered to be very low.

Oil spills pose the greatest threat to coastal and marine birds by direct oiling, food source contamination, or nesting habitat pollution. It is assumed that one large oil spill (greater than or equal to 1,000 bbl) will occur during the 39-year lease life. The highest estimated probability of oiling, contamination, or pollution involving coastal and marine birds is 2 percent. The impact level from this factor is considered to be very low.

It follows that activities resulting from the proposed action have the potential to cause very low impacts to coastal and marine birds. There will be no discernible decline in a coastal or marine bird population or species, and no change in distribution or abundance. Any individuals experiencing sublethal effects will recover to pre-impact condition in less than one generation.

Conclusion

A very low level of impact on coastal and marine birds is estimated to occur in the Central Gulf as a result of the Base Case.

(8) Impacts on the Commercial Fishing Industry

Several impact-producing factors may threaten the commercial fishing industry.

The emplacement of one production platform eliminates approximately 3.7 ha (9 ac) of commercial trawling space. Twenty-five offshore platform/structures will be constructed, removing 91 ha (225 ac) from commercial trawling. This represents an inconsequential amount of the total trawling area. The impact from this factor is considered to be very low.

In addition to toxic trace elements and hydrocarbons in produced waters that are discharged into inshore and coastal waters, there are additional components and properties, such as hypersalinity and hypoxia, that adversely affect commercial fishing resources. A maximum of 52,000 bbl/day of OCS-produced water will be discharged in Louisiana coastal waters during the peak year. The impact level to essential habitat proximate to the discharge site is considered to be high. The impact level to the commercial fishing industry is considered to be low.

Oil spills pose the greatest threat to the commercial fishing industry by direct contact with eggs, larvae, juveniles, or massed spawning adult finfish or shellfish; by contamination of essential estuarine nursery habitat; or by deterrence of commercial fishing activity. It is assumed that one large oil spill (greater than or equal to 1,000 bbl) will occur during the 39-year lease life. The highest estimated probability of contact and affect, contamination, or deterrence involving commercial fishing resources is 2 percent. The impact from this factor is considered to be low.

It follows that activities resulting from the proposed action have the potential to cause low level impacts to the commercial fishing industry. There will be little discernible decline in populations of commercial importance, in the quality of essential habitats, or in commercial fishing activity. Recruitment will return any affected population, habitat, or activity to pre-impact level and/or condition within one generation.

Conclusion

A low level of impact on the commercial fishing industry is estimated to occur in the Central Gulf as a result of the Base Case.

(9) Impacts on Recreational Beach Use

Small oil spills are likely to affect portions of CPA beaches, with little disruption of recreational activities. Marine debris loss from OCS operations associated with drilling 540 new wells and producing oil and gas from 25 new platforms throughout the CPA over the next 39 years will occur from time-to-time; however, the impact from intermittent washup of debris on Louisiana and Texas beaches should be very low.

Conclusion

The proposed action is expected to result in a low impact on the use and appreciation of recreational beaches.

(10) Impacts on Archaeological Resources

(a) Historic

The greatest impact to an historic cultural resource as a result of the proposed action would result from a contact between an OCS offshore activity (platform installation, drilling rig emplacement, and pipeline projects) and an historic shipwreck. The archaeological surveys that are conducted prior to initiating oil and gas activities within a lease block are estimated to be 90 percent effective at locating historic shipwrecks in areas where sidescan sonar is effective at identifying shipwrecks. In areas where sidescan sonar is ineffective because of thick accumulations of sediment on the seafloor (these areas roughly account for 40% of the CPA), magnetometer data, which is estimated at being only 25 percent effective at locating ferrous objects at the 150-m line spacing used in the archaeological survey, will be the only means to detect shipwrecks. A recently completed, MMS-funded study (Garrison et al., 1989) has provided new data on shipwreck locations.

Other activities associated with the proposed action are expected to have very low impacts on historic archaeological resources. No new onshore infrastructure construction or pipeline landfalls are expected as a result of the proposed action. Historic cultural resources, therefore, will not be affected by these activities. The chances of contact from an oil spill associated with the proposed action is very low. Furthermore, the impact from an oil-spill contact on an historic coastal site, such as a fort or a lighthouse, would be visual due to oil contamination. These impacts would be temporary and reversible.

To summarize, because of incomplete knowledge on the location of shipwrecks in the Gulf, an OCS activity could contact a shipwreck. Although this occurrence is not probable, such an event would result in the disturbance or destruction of important historic archaeological information. Other factors associated with the proposed action are not expected to affect historic archaeological resources. The impact level of the proposed action is expected to be moderate because of a low probability of the possibility of a contact between an OCS activity and an historic shipwreck.

Conclusion

The level of impact to historic sites in the Central Gulf as a result of the proposed action is expected to be moderate.

(b) Prehistoric

Several impact-producing factors may threaten the prehistoric archaeological resources of the Central Gulf. An impact could result from a contact between an OCS activity (pipeline and platform installations, drilling rig emplacement and operation, and anchoring activities) and a prehistoric site located on the continental shelf. The archaeological surveys that are required prior to an operator beginning oil and gas activities in a lease block are estimated to be 90 percent effective at identifying possible prehistoric sites. Since the survey provides a significant reduction in the potential for a damaging interaction between an impact-producing factor and a prehistoric site, the impact level from this event is considered to be very low.

Onshore development as a result of the proposed action could result in the direct physical contact between new facility construction, pipeline trenching, and navigation canal dredging. None of these activities are expected to occur under the Base Case. The impact level from these factors is considered to be very low.

Should an oil spill contact a coastal prehistoric site, the potential for dating the site using radiocarbon methods could be destroyed. Previously unrecorded sites could also experience an impact from oil spill cleanup operations on beaches. The probability of a large spill contacting a coastal prehistoric site is very low (0.5%-3%), and it is assumed that no contact will occur. A few spills greater than 1 and less than or equal to 50 bbl are assumed to contact the coast, but these small spills would not cover an exposed site, such as a shell midden, with enough oil to contaminate all the dateable organic remains. The impact level from oil-spill contact is expected to be very low.

Conclusion

The level of impact to prehistoric sites in the Central Gulf as a result of the proposed action is expected to be very low.

c. Potential Mitigating Measures

(1) Topographic-features Stipulation

The topographic features of the Central Gulf provide habitat for coral and coral community organisms (Section III.B.2.c.). As discussed in Section IV.D.1.a.(2)(c), these communities would be severely and adversely impacted (i.e., have an expected impact level of "very high") by unrestricted oil and gas activities resulting from the proposed action if such activities took place on or near these communities. The DOI has recognized this problem for some years, and since 1974 stipulations have been made a part of leases on blocks on or near these biotic communities so that impacts from nearby oil and gas activities were mitigated to the greatest extent possible. This stipulation would not prevent the recovery of oil and gas resources, but it would serve to protect valuable and sensitive biological resources. The stipulation is presented as an option for the Secretary's consideration.

The Topographic-features Stipulation was formulated based on consultation with various Federal agencies and comments solicited from State, industry, environmental organizations, and academic representatives. The stipulation wording is based on years of scientific information collected since the inception of the stipulation. This information includes various Bureau of Land Management/MMS-funded studies on the topographic highs in the Central Gulf, numerous stipulation-imposed, industry-funded monitoring reports, and the National Research Council (NRC) report entitled *Drilling Discharges in the Marine Environment* (1983).

The requirements in the stipulation are based on the following facts:

(a) Shunting of the drilling effluent to the nepheloid layer confines the effluent to a level deeper than that of the living reef of a high relief topographic feature. Shunting is therefore an effective measure for protecting the biota of high relief topographic features (Bright and Rezak, 1978; Rezak and Bright, 1981; NRC, 1983).

(b) Biological effect on the benthos from the deposition of unshunted discharge is mostly limited to within 1,000 m of the discharge (NRC, 1983).

(c) The biota of topographic features can be categorized into depth-related zones defined by degree of reef-building activity (Rezak and Bright, 1981; Rezak et al., 1983 and 1985).

The stipulation would establish No Activity Zones at the topographic features. The zone is defined by the 85-m isobath because, generally, the biota shallower than 85 m are more typical of the Caribbean reef biota, while the biota deeper than 85 m are similar to soft-bottom organisms found throughout the Gulf. Where a bank is in water depths less than 85 m, the deepest closing isobath defines the No Activity Zone for that bank. Within the No Activity Zone, no operations, anchoring, or structures would be allowed.

Outside the No Activity Zones, additional restrictive zones would be established within which oil and gas operations could occur, but within which drilling discharges would be shunted.

The stipulation would require that all effluents within 1,000 m of those banks with the antipatharian-transitional zone be shunted to within 10 m of the seafloor. Banks containing the more sensitive and productive algal-sponge zone would require a shunt zone extending 1 nmi and an additional 3-nmi shunt zone for development. (The reported algal-sponge zone at Sackett Bank is mostly dead; Sackett Bank is, therefore, not accompanied by this restriction.) Because Sweet Bank in the Central Gulf is small and surrounded by very deep water (the depth drops very quickly to greater than 200 m around the bank), it does not require the protection of the shunt zones; therefore, only a "No Activity Zone" would be established there.

These are banks that would cause this stipulation to be applied to blocks of the Central Gulf:

Bank Name	Isobath (meters)	Bank Name	Isobath (meters)
McGrail Bank	85	Parker Bank	85
Bouma Bank	85	Fishnet Bank[2]	76
Rezak Bank	85	Jakkula Bank	85
Sidner Bank	85	Sweet Bank[1]	85
Sonnier Bank	55	Rankin Bank	85
Sackett Bank[2]	85	29 Fathom Bank	64
Ewing Bank	85	Bright Bank	85
Diaphus Bank[2]	85	Geyer Bank[3]	85
Alderdice Bank	80	MacNeil Bank[3]	82

[1] Only paragraph (a) of the stipulation applies.
[2] Only paragraphs (a) and (b) apply.
[3] Western Gulf of Mexico bank with a portion of its "3 Mile Zone" in the Central Gulf of Mexico.

The stipulation reads as follows:

Topographic Features Stipulation
(Central Planning Area)

(a) No activity including structures, drilling rigs, pipelines, or anchoring will be allowed within the listed isobath ("No Activity Zone") of the banks as listed above.

(b) Operations within the area shown as "1,000 Meter Zone" shall be restricted by shunting all drill cuttings and drilling fluids to the bottom through a downpipe that terminates an appropriate distance, but no more than ten meters, from the bottom.

(c) Operations within the area shown as "1 Mile Zone" shall be restricted by shunting all drill cuttings and drilling fluids to the bottom through a downpipe that terminates an appropriate distance, but no more than ten meters, from the bottom. (Where there is a "1 Mile Zone" designated, the "1,000 Meter Zone" in paragraph (b) is not designated.)

(d) Operations within the area shown as "3 Mile Zone" shall be restricted by shunting all drill cuttings and drilling fluids from development operations to the bottom through a downpipe that terminates an appropriate distance, but no more than ten meters, from the bottom.

Effect of the Lease Stipulation

The purpose of the stipulation is to protect the biota of the topographic features from adverse effects due to routine oil and gas activities; if adopted, the stipulation would reduce the expected impact level from very high to very low. Such effects include physical damage from anchoring and rig emplacement and potential toxic and smothering effects from muds and cuttings discharges. The topographic features stipulation has been used on leases since 1974, and this experience shows conclusively that the stipulation works to prevent damage to the biota of these banks from routine oil and gas activities. Anchoring on the sensitive portions of the features by the oil and gas industry has been prevented. Monitoring studies conducted as required by the stipulation have demonstrated that the shunting requirements are effective in preventing the muds and cuttings from impacting the biota of the banks. The potential stipulation, if implemented, would continue to protect the biota of the banks, specifically as discussed below.

Mechanical damage resulting from oil and gas operations is probably the single most severe impact to benthic areas. The "No Activity Zone" designation would completely eliminate this threat from leasing activities. The sensitive biota within the zones would thus be protected.

The stipulation would require that all effluents within 1,000 m of Sackett, Fishnet, and Diaphus Banks, categorized by Rezak and Bright (1981) as Category C banks, be shunted into the nepheloid layer.

The categories of Rezak and Bright (1981) and their definitions are as follows:

> Category A: zone of major reef-building activity; maximum environmental protection recommended;
> Category B: zone of minor reef-building activity; environmental protection recommended;
> Category C: zone of negligible reef-building activity, but crustose algae present; environmental protection recommended; and
> Category D: zone of no reef-building or crustose algae; protection not recommended.

The biota of the antipatharian zone located at these banks would thus be protected from impact from drilling discharges within the 1,000-m zone because the potentially harmful materials (in drilling muds) would be trapped in the bottom boundary layer and would not get up on the bank where the biota of concern are located. Surface drilling discharge at distances greater than 1,000 m from the bank is not expected to impact the biota since effects from drilling discharge are limited to 1,000 m.

The stipulation would protect the remaining Category A and B banks with greater restrictions. Surface discharge would not be allowed within 1 nmi of these more sensitive banks. Thus, the stipulation would prevent impacts to the biota of these sensitive banks from drilling discharges within 1 nmi. Surface discharges outside of 1 nmi are not expected to impact the biota of the banks, as effects from surface discharge are limited to 1,000 m. However, it is possible that because multiple wells from a single platform (surface location) are typically drilled during development operations, extremely small amounts of muds discharged more than 1 nmi from the bank may reach the bank. In order to eliminate the possible cumulative effect of muds discharged during development drilling outside of 1 nmi, the stipulation would impose a "3 Mile Zone" in which shunting of development well effluent would be required.

The stipulation would prevent damage to the biota of the banks from routine oil and gas activities resulting from the proposed action. Furthermore, oil and gas resources present near such areas could be recovered. However, the stipulation would not protect the banks from the adverse effects of an accident such as a large blowout on a nearby oil or gas operation.

(2) Live-bottom (Pinnacle Trend) Stipulation

A small portion of the northeastern CPA is characterized by a pinnacle trend, which is classified as a live bottom under the definition in the stipulation. The pinnacles in the region could be impacted from physical damage of unrestricted oil and gas activities, as noted in Section IV.D.1.a.(2)(a). The Live-bottom Stipulation is intended to protect the pinnacle trend and the associated hard-bottom communities from damage and, at the same time, provide for recovery of potential oil and gas resources.

The stipulation reads as follows:

> Live-bottom (Pinnacle Trend) Stipulation
> (Central Planning Area)
>
> (To be included only on leases in the following blocks: Main Pass Area, South and East Addition Blocks 219-226, 244-266, 276-288; Viosca Knoll Blocks 521, 522, 564, 565, 566, 609, 610, 654, 692-698.)
>
> For the purpose of this stipulation, "live bottom areas" are defined as seagrass communities; or those areas which contain biological assemblages consisting of such sessile invertebrates as sea fans, sea whips, hydroids, anemones, ascidians, sponges, bryozoans, or corals living upon and attached to naturally occurring hard or rocky formations with rough,

broken, or smooth topography; or areas whose lithotope favors the accumulation of turtles, fishes, and other fauna.

Prior to any drilling activities or the construction or placement of any structure for exploration or development on this lease, including, but not limited to, anchoring, well drilling, and pipeline and platform placement, the lessee will submit to the Regional Director (RD) a live bottom survey report containing a bathymetry map prepared utilizing remote sensing techniques. The bathymetry map shall be prepared for the purpose of determining the presence or absence of live bottoms which could be impacted by the proposed activity. This map shall encompass such an area of the seafloor where surface disturbing activities, including anchoring, may occur.

If it is determined that the live bottoms might be adversely impacted by the proposed activity, the RD will require the lessee to undertake any measure deemed economically, environmentally, and technically feasible to protect the pinnacle area. These measures may include, but are not limited to, the following:

(a) the relocation of operations; and (b) the monitoring to assess the impact of the activity on the live bottoms.

Effect of the Lease Stipulation

The pinnacle trend is known to exist as patchy regions within the general area of the eastern portion of the CPA (Ludwick and Walton, 1957; Vittor and Associates, Inc., 1985; Brooks et al., 1989). The stipulation would operate to locate the individual pinnacles and associated communities that may be present in the block. The stipulation would require that a survey be done to encompass the potential area of proposed surface disturbance and that a bathymetry map be made from this survey. The bathymetry map would depict any pinnacles in the vicinity of the proposed activity. (Since it is the pinnacles themselves and the habitat they provide for various species that are sensitive to impacts from oil and gas activities, photodocumentation of the identified pinnacles is not warranted.) The RD, through consultation with FWS, could then decide if pinnacles in the trend would be potentially impacted and, if so, require any appropriate mitigative measures.

By identifying the individual pinnacles present at the activity site, the lessee could be directed to avoid placement of the drilling rig and anchors on the sensitive areas. Thus, mechanical damage to the pinnacles would be eliminated by the imposition of the stipulation. The potential stipulation does not address the discharge of effluents near the pinnacles because the pinnacle trend is subjected to heavy natural sedimentation and is at considerable depths. The rapid dilution of drill cuttings and muds will minimize the potential of significant concentration of effluents on the pinnacles.

The Live-bottom Stipulation has been used on leases since 1976. Experience from the use of the Live-bottom Stipulation in the Central and Eastern Gulf shows that the stipulation works to identify and protect the live bottom biota, while also allowing for the exploration and development of potential hydrocarbon resources.

(3) Archaeological Resource Stipulation

(a) "Archaeological resource" means any prehistoric or historic district, site, building, structure, or object (including shipwrecks); such term includes artifacts, records, and remains which are related to such a district, site, building, structure, or object (16 U.S.C. 470w(5)). "Operations" means any drilling, mining, or construction or placement of any structure for exploration, development, or production of the lease.

(b) If the Regional Director (RD) believes an archaeological resource may exist in the lease area, the RD will notify the lessee in writing. The lessee shall then comply with subparagraphs (1) through (3).

(1) Prior to commencing any operations, the lessee shall prepare a report, as specified by the RD, to determine the potential existence of any archaeological resource that may be affected by operations. The report, prepared by an archaeologist and geophysicist, shall be based on an assessment of data from remote-sensing surveys and of other pertinent archaeological and environmental information. The lessee shall submit this report to the RD for review.

(2) If the evidence suggests that an archaeological resource may be present, the lessee shall either:

(i) Locate the site of any operation so as not to adversely affect the area where the archaeological resource may be; or

(ii) Establish to the satisfaction of the RD that an archaeological resource does not exist or will not be adversely affected by operations. This shall be done by further archaeological investigation, conducted by an archaeologist and a geophysicist, using survey equipment and techniques deemed necessary by the RD. A report on the investigation shall be submitted to the RD for review.

(3) If the RD determines that an archaeological resource is likely to be present in the lease area and may be adversely affected by operations, he will notify the lessee immediately. The lessee shall take no action that may adversely affect the archaeological resource until the RD has told the lessee how to protect it.

(c) If the lessee discovers any archaeological resource while conducting operations on the lease area, the lessee shall report the discovery immediately to the RD. The lessee shall make every reasonable effort to preserve the archaeological resource until the RD has told the lessee how to protect it.

Effect of the Lease Stipulation

The lease stipulation is only a mechanism whereby MMS can require the lessee to conduct a survey prior to development. In the absence of a lease stipulation, MMS would still be required to ensure that an archaeological survey was conducted prior to lease development in areas having a high probability for site occurrence. The Federal Government's authority for archaeological resource management on the OCS is based on the requirements of the National Historic Preservation Act of 1966, as amended; Executive Order 11593; and the OCSLA, as amended. The lease stipulation in and of itself does not reduce the potential impact to archaeological resources. However, by providing a mechanism whereby a remote-sensing survey can be conducted prior to development, it is a very effective way to mitigate potential impacts to archaeological resources.

(4) Military Areas Stipulation

The military areas stipulation has been applied to blocks in military warning and water test areas in past lease sales in the Central Gulf. These areas are shown on Visual No. 3. The military has recommended utilizing the stipulation on all leasing operations within their warning areas.

The stipulation reads as follows:

Military Areas Stipulation No. 1

Hold and Save Harmless

Whether compensation for such damage or injury might be due under a theory of strict or absolute liability or otherwise, the lessee assumes all risks of damage or injury to persons or property, which occur in, on, or above the Outer Continental Shelf (OCS), to any persons or to any property of any person or persons who are agents, employees, or invitees of the lessee, its agents, independent contractors, or subcontractors doing business with the lessee in connection with any activities being performed by the lessee in, on, or above the OCS, if such injury or damage to such person or property occurs by reason of the activities of any Agency of the United States Government, its contractors or subcontractors, or any of its officers, agents or employees, being conducted as a part of, or in connection with, the programs and activities of the command headquarters listed in Table II-1.

Notwithstanding any limitation of the lessee's liability in Section 14 of the lease, the lessee assumes this risk whether such injury or damage is caused in whole or in part by any act or omission, regardless of negligence or fault, of the United States, its contractors or subcontractors, or any of its officers, agents, or employees. The lessee further agrees to indemnify and save harmless the United States against all claims for loss, damage, or injury sustained by the lessee, or to indemnify and save harmless the United States against all claims for loss, damage, or injury sustained by the agents, employees, or invitees of the lessee, its agents, or any independent contractors or subcontractors doing business with the lessee in connection with the programs and activities of the aforementioned military installation, whether the same be caused in whole or in part by the negligence or fault of the United States, its contractors, or subcontractors, or any of its officers, agents, or employees and whether such claims might be sustained under a theory of strict or absolute liability or otherwise.

Electromagnetic Emissions

The lessee agrees to control its own electromagnetic emissions and those of its agents, employees, invitees, independent contractors or subcontractors emanating from individual designated defense warning areas in accordance with requirements specified by the commander of the command headquarters listed in Table II-1 to the degree necessary to prevent damage to, or unacceptable interference with Department of Defense flight, testing, or operational activities, conducted within individual designated warning areas. Necessary monitoring control, and coordination with the lessee, its agents, employees, invitees, independent contractors or subcontractors, will be affected by the commander of the appropriate onshore military installation conducting operations in the particular warning area; provided, however, that control of such electromagnetic emissions shall in no instance prohibit all manner of electromagnetic communication during any period of time between a lessee, its agents, employees, invitees, independent contractors or subcontractors and onshore facilities.

Operational

The lessee, when operating or causing to be operated on its behalf, boat, ship, or aircraft traffic into the individual designated warning areas, shall enter into an agreement with the commander of the individual command headquarters listed in Table II-1, upon utilizing an individual designated warning area prior to commencing such traffic. Such an agreement will provide for positive control of boats, ships, and aircraft operating into the warning areas at all times.

Table II-1

Military Contacts

Central Gulf of Mexico

Warning Areas	Command Headquarters
W-155 (for agreement)	Chief, Naval Air Training Naval Air Station Corpus Christi, Texas 78419-5100 Telephone: (512) 939-3927/3902
W-155 (for plans and operations)	Fleet Area Control & Surveillance Facility (FACSFAC) Naval Air Station Pensacola, Florida 32508 Telephone: (904) 452-2735/4671
W-92	Naval Air Station Air Operations Department Air Traffic Division/Code 52 New Orleans, Louisiana 70146 Telephone: (504) 393-3208/3106
W-453	159th Tactical Fighter Group (ANG) NAS NOLA New Orleans, Louisiana 70143 Telephone: (504) 393-3521/3377
Eglin Water Test Areas 1-3	Commander Munitions Systems Division 3246th Test Wing/CA Eglin AFB, Florida 32542 Telephone: (904) 882-3614

Western Gulf of Mexico

Warning Areas	Command Headquarters
W-228	Chief, Naval Air Training Naval Air Station Corpus Christi, Texas 78419-5100 Telephone: (512) 939-3927/3902
W-602	Director, Air Space Management Deputy Chief of Staff Operations Headquarters Strategic Air Command Offutt AFB, Nebraska 68113-5001 Telephone: (402) 294-3103/3450

Table II-1. Military Contacts (continued)

Eastern Gulf of Mexico

Warning Areas	Command Headquarters
W-151, W-168, W-470, and Eglin Water Test Areas 1-5	Commander Munitions Systems Division 3246th Test Wing/CA Attention: Aubrey Freeman/CCN Eglin AFB, Florida 32542 Telephone: (904) 882-3614
W-155 (for agreement)	Chief, Naval Air Training Naval Air Station Corpus Christi, Texas 78419-5100 Telephone: (512) 939-3927/3902
W-155 (filing plans and operations)	Fleet Area Control & Surveillance Facility (FACSFAC) Naval Air Station Pensacola, Florida 32508 Telephone: (904) 452-2305
W-155 (for operational control)	Fleet Area Control & Surveillance Facility (FACSFAC) Naval Air Station Pensacola, Florida 32508 Telephone: (904) 452-2735/4671
W-174	Naval Air Training Command Naval Air Station Air Operations/Tarpon Key West, Florida 33040 Telephone: (305) 292-2954
Naval Coastal System Center (NCSC) Area	Naval Coastal System Center Code 530 Panama City, Florida 32407 Telephone: (904) 234-4626/4280

Effect of the Lease Stipulation

The hold harmless section of the military stipulation serves to protect the U.S. Government from liability in the event of an accident involving the lessee and military activities. The actual operations of the military and the lessee and its agents will not be affected.

The electromagnetic emissions section of the stipulation requires the lessee and its agents to reduce and curtail the use of radio, CB, or other equipment emitting electromagnetic energy within some areas. This serves to reduce the impact of oil and gas activity on the communications of military missions and reduces the possible effects of electromagnetic energy transmissions on missile testing, tracking, and detonation.

The operational section requires notification to the military of oil and gas activity to take place within a military use area. This allows the base commander to plan military missions and maneuvers that will avoid the areas where oil and gas activities are taking place or to schedule around these activities. Prior notification helps reduce the potential impacts associated with vessels and helicopters traveling unannounced through areas where military activities are underway.

The military stipulation reduces potential impacts, particularly in regards to safety, but does not reduce or eliminate the actual physical presence of oil and gas operations in areas where military operations are conducted. The reduction in potential impacts resulting from this stipulation makes multiple-use conflicts most unlikely. Without the stipulation, some potential conflict is likely. The best indicator of the overall effectiveness of the stipulation may be that there has never been an accident involving a conflict between military operations and oil and gas activities.

2. Alternative B - Delete Biologically Sensitive Offshore Habitats

This deletion option is offered for the Secretary's consideration and would protect valuable offshore biological resources. It affects the biologically sensitive banks (topographic features) of the Central Gulf.

All of the blocks included in the deletion alternative are also the blocks that would be covered by the Topographic-features Stipulation (discussed in Section II.A.1.c.(1)), which may be adopted by the Secretary to protect the biological habitats of these areas. Furthermore, the Secretary may choose to adopt only a part of this alternative, either alone or in conjunction with the proposed biological stipulation, in order to promote the environmental protection policies of the Department.

Description of the Alternative

This deletion alternative would delete the 54 unleased blocks (Figures II-1 and II-2) of the total 167 blocks (these blocks are listed in Appendix A) that are on or near enough to biologically sensitive areas of the topographic features of the CPA so that activities resulting from the proposed action could have a high probability of impacting these biota. These 54 blocks represent about 1.0 percent of the 5,204 blocks to be offered in the Central Gulf.

Impact Analysis

The following analysis is presented to provide an indication of any change in environmental protection provided under Alternative B as compared with the estimated impacts of Alternative A (the proposed action). Descriptions of the environmental resources of the area are provided in Section III of this document and descriptions of the potential impact-producing factors are provided in Section IV.A. Detailed analyses of the estimated impacts of the proposed action are located in Section IV.D.3. Please reference these sections for more detailed information of the resources, impact-producing factors, and estimated impacts discussed below.

Given the size of the area available for lease under Alternative A, it is reasonable to assume that the removal of 1.0 percent of the area probably will not significantly change the projected level of activity (i.e., numbers of wells, platforms, vessel trips, etc. (Table IV-1)) projected under that alternative. The only differences are that under Alternative B no activity will take place in the deletion areas. The assumption that the levels of activity for Alternative B are virtually identical to those projected for Alternative A indicates that the impacts expected to result will be very similar to those described under Alternative A (Section IV.D.1.a).

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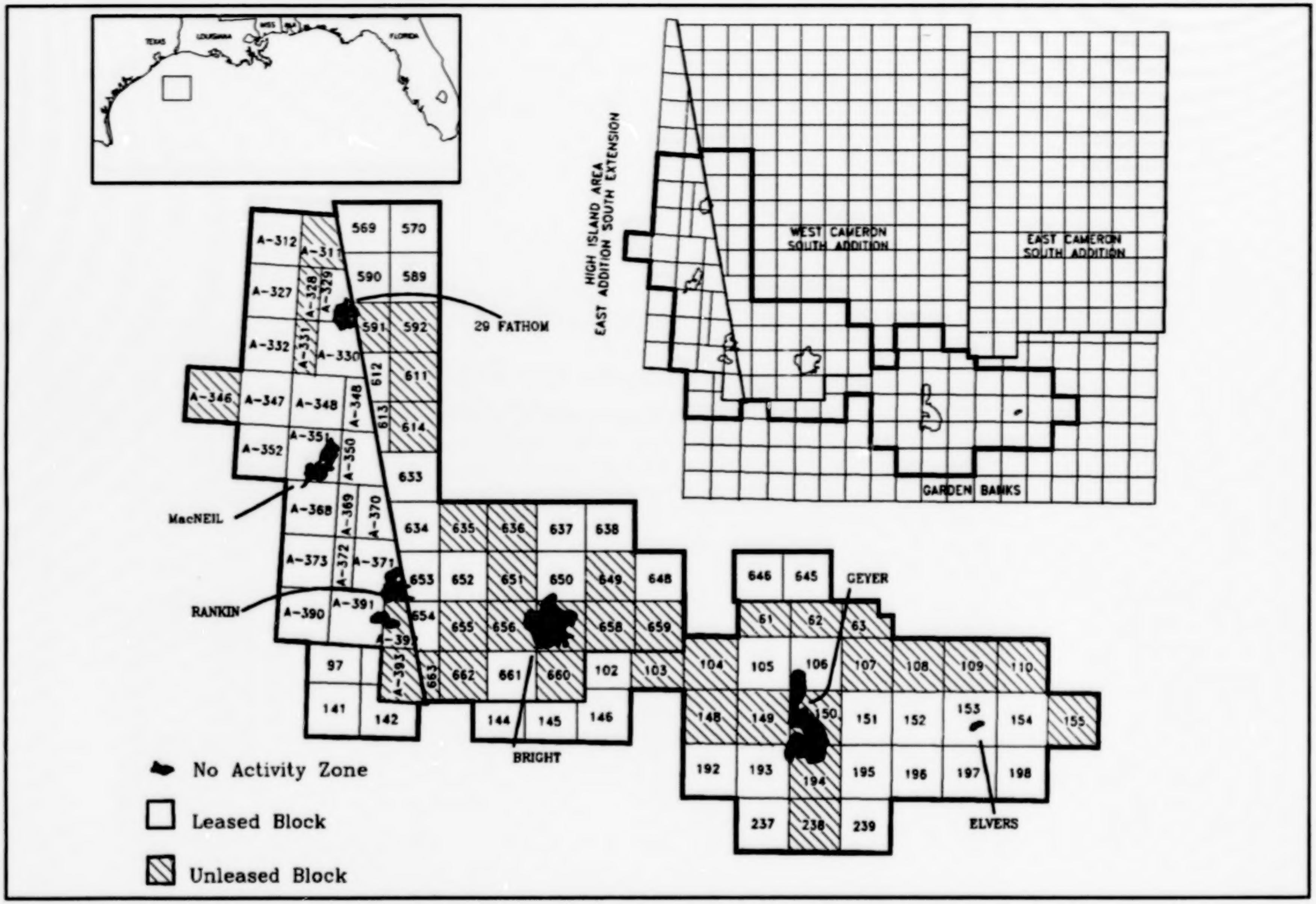

Figure II-1. Location and Lease Status of Blocks Affected by Alternative B (West Louisiana).

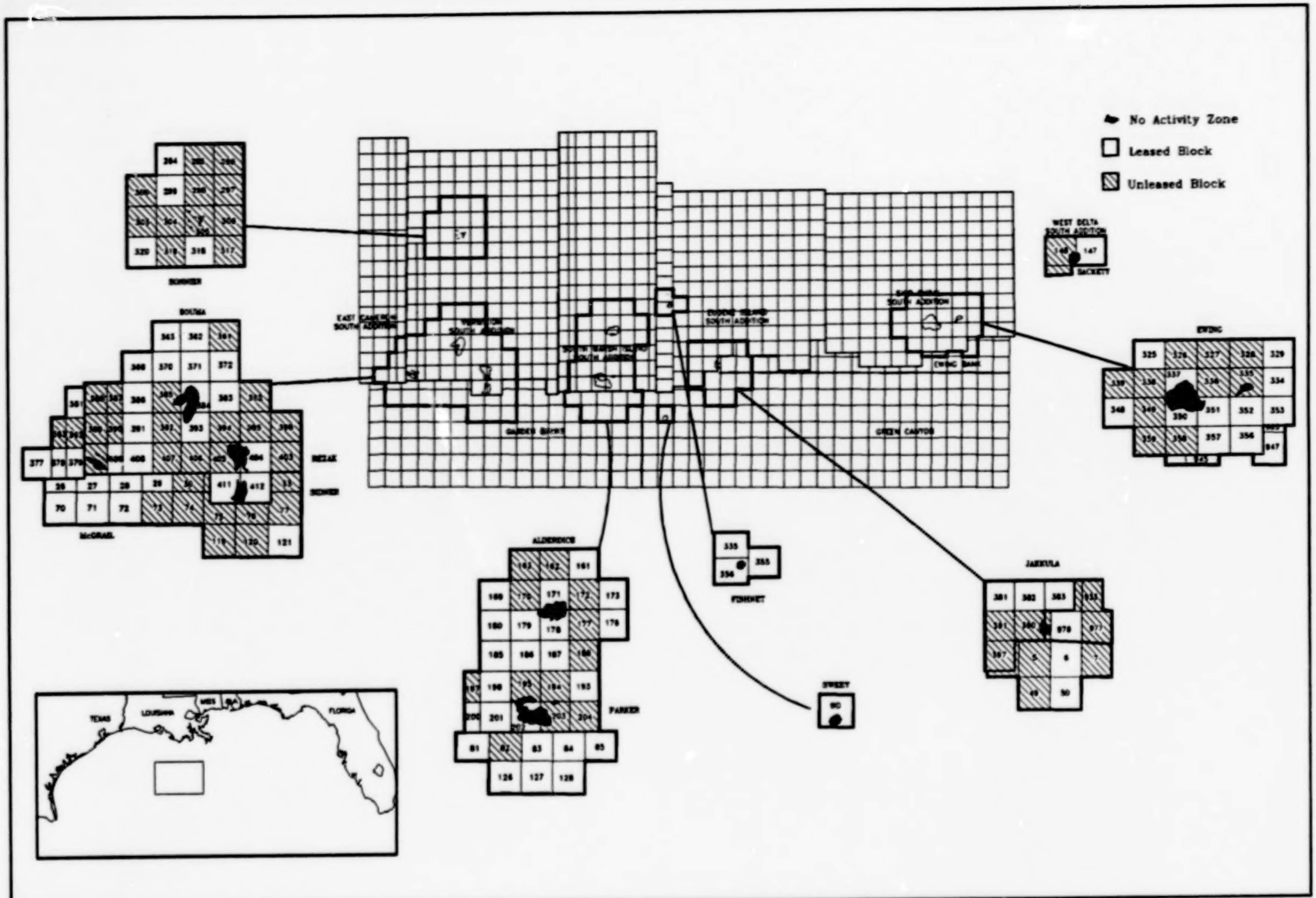

Figure II-2. Location and Lease Status of Blocks Affected by Alternative B (East Louisiana).

The areas make up only a small portion of the CPA, and with the exception of topographic features, only contain small amounts, if any, of the resources analyzed in this document. Therefore, the regional impact levels for all resources except topographic features are estimated to be identical to those described under Alternative A. However, there are some localized changes in the impacts as described below.

Coastal Resources

The coastal environments of the CPA include beaches, seagrass beds, salt and fresh marshes, and estuaries. The beaches serve as recreational sites in addition to storm protection and erosion control areas. The marshes and estuaries support numerous commercially and recreationally important fishery and wildlife species. The primary impact-producing factors of concern for these environmental resources are contact by oil spills and disturbance from the emplacement of pipelines or the dredging of channels.

The areas that would be deleted from the proposed sale with the selection of Alternative B are scattered across the shelf of the CPA far from the coastline. All of the areas available for deletion, with one exception, are located over 115 km (70 mi) from shore (Sackett Bank with a 2 1/4 block deletion area is located about 30 km (18 mi) from the mouth of the Mississippi River). Considering the assumption that the estimated level of activity will not change from that projected for Alternative A and the substantial distances from the deletion areas to coastal resources, it is extremely unlikely that selection of Alternative B would have any influence on the impacts estimated for Alternative A.

Conclusion

The impacts on the following coastal resources are estimated to be the same as those estimated under Alternative A: coastal barriers (very low); wetlands (very low); coastal and nearshore water quality (low); air quality (very low); the federally protected piping plover (low); and brown pelican (low); coastal and marine birds (very low); and recreational beach use (low).

Offshore Resources

Deletion of this area would preclude drilling operations and associated activities from occurring within the affected blocks. It would further eliminate the threat of damage from drilling discharges, anchoring, or platform/pipeline emplacement related to the exploration and development of this area. The following analyses deal specifically with the sensitive resources that may exist in the deletion area and for which there might be a change in impacts with the selection of Alternative B. Live-bottom areas (Pinnacle Trend), deep-water benthic communities, and archaeological resources are not located in or near the area, so there would be no change in the impact level projected under Alternative A. Those levels are as follows: live-bottom areas (low), deep-water benthic communities (low density, low; high density; moderate) and archaeological resources (historic, moderate; prehistoric, very low).

Topographic Features

Essentially, oil and gas operations within the blocks that fall within 3 nmi of the 85-m isobath of the 16 banks of the Central Gulf (and 2 banks of the Western Gulf that are within 3 nmi of the Central Gulf) are considered potential sources of impact to biota of those banks that could be harmed by oil and gas activities. The biological resources of the topographic features are considered very sensitive to potential impacts due to oil and gas operations; however, topographic features in the Central Gulf are usually the surface expressions of salt domes, which are often associated with oil and gas reserves. The recovery of such reserves, the extent of which is unknown at this time, would be prevented by the adoption of this alternative. However, it is noted that 113 of the 167 blocks affected are already leased. This deletion alternative is presented in order to fully protect the biological resources inhabiting the crests of the topographic features.

This deletion, if adopted, would prevent any oil and gas activity whatsoever in the affected blocks (except for pipeline construction, which would be regulated through the normal pipeline permitting procedures); thus, it would eliminate any impacts to the biota of the area from oil and gas activities, which otherwise would be conducted within the blocks. Deleting this small percentage of the Central Gulf area would result in a very large reduction of the potential impacts to these high-value biological resources as compared with Alternative A.

Conclusion

Selection of Alternative B would reduce the impacts to the biota of the topographic features to very low (from the very high of Alternative A).

Offshore Water Quality

The impact-producing factors leading to water quality degradation resulting from offshore OCS oil and gas operations include the resuspension of bottom sediments through exploration and development activities, pipeline construction, and platform removal operations; the discharge of deck drainage, sanitary and domestic wastes, formation waters (produced waters), and drilling fluids (muds and cuttings); and accidental hydrocarbon discharges due to spills, blowouts, or pipeline leaks. All of these factors, except the last, impact only very small areas near the source and for only a short time; the last factor is estimated to be very unlikely to occur. Thus, adoption of this alternative would completely eliminate all but the last factor as a threat to the water quality of the area. However, because the area is a small portion of the entire area offered for leasing, the regional impact level will be reduced by only that small amount, assuming that oil and gas activities would be reduced proportionally.

Conclusion

Selection of Alternative B would eliminate potential impacts on very localized areas contained in the deletion area, but this would not be significant enough to change the regional impact level on offshore water quality as projected under Alternative A (low).

Endangered and Threatened Species and Marine Mammals

Subadult and adult loggerhead, green, hawksbill, and Kemp's ridley sea turtles are unlikely to occur in the proposed deletion area because the topographic features in the CPA and WPA are at depths in excess of the preferred habitat for these species and lifestages. However, their hatchlings and leatherback sea turtles could occur in the vicinity of any of these areas. Sperm whales have been sighted near topographic features in the CPA and several of the more common small cetaceans--*Stenella, Kogia,* and *Grampus*--could be expected in the vicinity of topographic features because of the presence of prey species. Sea turtles and marine mammals could be impacted by oil and gas activities in this area by contact with or ingestion of oil, collision with vessels, entanglement in or ingestion of debris generated from platforms, or physical/acoustic disturbances (drilling, structure placement and removal). Deletion of this area from the sale would eliminate all impacts to sea turtles and marine mammals that would occur from proposed action-related oil and gas operations within the deletion area. If the area is not deleted from the proposed sale, impacts to marine mammals and sea turtles will not change significantly from those of the proposed action because of the low level of oil and gas activity proposed and the small number of marine mammals and sea turtles in the area. To the extent that they are present in this small portion of the CPA, regional impacts to these species will be reduced by that same small amount.

Conclusion

Selection of Alternative B would reduce potential impacts on endangered species and marine mammals in and near the deletion area, but the regional reduction would not be significant enough to change the regional impact level on these resources as projected under Alternative A: Kemp's ridley sea turtle (moderate); loggerhead sea turtle (low); great whales (low); Gulf sturgeon (low); and marine mammals (low).

3. Alternative C - No Action

Description of the Alternative

The alternative is equivalent to cancellation of a sale scheduled for a specific timeframe on the approved 5-year OCS Oil and Gas Leasing Schedule. Sales in the Central Gulf are scheduled on an annual basis. By canceling the proposed sale, the opportunity is postponed or foregone for development of the estimated 0.13 BBO and 1.21 tcf of gas that could have resulted from Proposed Sale 131 in the Central Gulf.

Effects of the Alternative

If Alternative C is selected, all impacts, positive and negative, associated with the proposed action would be canceled. This alternative would therefore result in no effect on the sensitive resources and activities discussed in Section IV.D.1.a. The incremental contribution of the proposed action to cumulative effects would also be foregone, but such effects from other activities, including other OCS sales, would remain. One contribution to cumulative effects that could increase is oil spill risk due to the importation of foreign oil to replace the resources lost through cancellation of the proposed action.

Alternative energy strategies that could provide replacement resources for lost domestic OCS oil and gas production include energy conservation; conventional oil and gas supplies; coal; nuclear power; oil shale; tar sands; hydroelectric power; solar and geothermal energy; and imports of oil, natural gas, and LNG. These are discussed in some detail in Appendix F. The energy equivalents that may be required from several alternative energy sources, should this lease sale be permanently cancelled, are shown on Table F-10 and are based on the resources estimated by MMS to be produced as a result of the proposed action. For the purpose of clarity, this table has separately identified each potential alternative source of energy regarding substitution requirements. It is unlikely, however, that there would be a single choice between these alternatives sources, but instead, some combined effort to explore and develop further many or all of these forms as a substitute for OCS oil and gas production.

4. Comparison of Alternatives

Table S-3 provides a comparison and summary of the impact levels of the proposed action (Alternative A), delete biologically sensitive offshore habitats (Alternative B), no action (Alternative C), and the cumulative analyses for Sale 131. The definitions of the levels of impact used are in Table S-6.

Alternative A (the Proposed Action, Base Case) has the potential to result in low to very low impacts to a majority of the resources analyzed, with the exceptions being air quality and sensitive offshore habitats. The level of impact on air quality is estimated to be moderate; whereas, the level of impact on sensitive offshore habitats range from low to very high (Table S-3). The level of impact for archaeological resources is anticipated to be very low in coastal areas. The biological and archaeological stipulations are being considered for adoption as mitigating measures. If the potential stipulations are adopted, the level of impact to biological resources would be reduced to very low; however, the level of impact for archaeological resources would remain the same as without the stipulation. One exception is historic shipwrecks in the eastern portion of the Central Gulf where the level of impact is still anticipated to be very high.

Alternative B (Delete Biologically Sensitive Offshore Habitats) would significantly reduce impacts to topographic features and would have the same levels of impact as Alternative A for the remainder of the resource categories listed in Table S-3.

Alternative C (No Action) equates to cancellation of the sale and would preclude any impacts to the resource categories listed in Table S-3 from the proposed action or other alternatives.

B. PROPOSED WESTERN GULF SALE 135

1. Alternative A - The Proposed Action

a. Description

Proposed Western Gulf Sale 135 is scheduled to be held in August 1991 and will offer approximately 4,792 unleased blocks (as of May 1990) comprising about 26.3 million acres in the WPA. The actual number of blocks offered for lease will differ from this figure by the number of blocks relinquished, canceled, and terminated less the number of blocks leased during proposed Sale 125, which is scheduled for August 1990. The sale area is located from 14 to 357 km offshore in water depths ranging from 8 to over 3,000 m. Excluded from this proposed action are Blocks A-375 (East Flower Garden Bank) and A-398 (West Flower Garden Bank) in High Island Area, East Addition, South Extension, which were deferred because of the environmentally sensitive nature of the biological communities located in the blocks. There are also alternatives to the proposed action and protective mitigating measures available for adoption. The alternatives are to delete biologically sensitive areas near topographic features or to take no action (cancel the sale). The potential mitigating measures are protection of biological resources (topographic features and Pinnacle Trend live bottoms), protection of archaeological resources, and mitigation of conflicts with military activities.

The analyses of impacts summarized below (Section II.B.1.b.) and described in detail in Section IV.D.2.a. are based on a development scenario (Base Case) formulated to provide a set of assumptions and estimates on the amounts, locations, and timing for OCS exploration, development, and production operations and facilities, both offshore and onshore. These are estimates only and not predictions of what will happen as a result of holding this proposed sale. Tables IV-2, IV-4, and IV-8 through IV-10 summarize major elements of the development scenario and related impact-producing factors for the proposed action. A detailed discussion of the development scenario and major related impact-producing factors is included in Section IV.A. The following major assumptions and estimates are included in the Base Case.

- The discovery and production of 0.05 BBO and 0.72 tcf of gas during the period 1993-2024.

- The drilling of 200 exploration and delineation wells during the period 1992-2002.

- The installation of 15 production platforms and the drilling of 110 development wells during the period 1993-2014.

- Oil and gas production beginning in 1993 and reaching peak annual production during the period 2006-2007 for oil (2.5 MMbbl/year) and during the period 2007-2008 for gas (34.6 bcf/year).

- Estimated drilling mud solid discharges of 1.41 MMbbl; estimated drill cutting discharges of 0.16 million cubic yards; and produced water discharges of 433 MMbbl offshore.

- All economic gas production and most oil production (78.8%) will be transported by pipeline to onshore oil terminals and gas processing facilities in the Western and Central coastal area. Some oil production (18.2%) will be transported via about 68 shuttle tanker trips to existing port/terminal facilities in the Western coastal area. The remaining oil production (about 3%) will be barged to shore terminals. Oil at the terminals will then move via the existing pipeline, barging, or trucking network to refineries located within the Gulf coastal zone.

- The construction of 121 km of offshore pipeline (gathering and mainline).

- Though the probability of a large oil spill occurring in the WPA is so small (7%) that such an event is unlikely, the occurrence of one spill of approximately 8,600 bbl is assumed for analytical purposes.

- Onshore support and processing are expected to be provided entirely from facilities (primarily in the Central and Western coastal areas) existing prior to the proposed action or from facilities established/constructed subsequent to the proposed action as a result of cumulative oil and gas activity (Federal OCS and other) occurring subsequent to the proposed action. No major facility construction is expected to occur solely as a result of the proposed action.

b. Summary of Impacts

The following are summaries of the detailed impact analyses that are included in Section IV.D.2.a. It is noted that these summaries are limited to the impact of the proposed action above (under the Base Case); the cumulative impacts, which are assessed in Section IV.D.2.a., are not summarized here. Table S-4 indicates the level of impact on each resource category estimated as a result of the cumulative factors.

Five levels of impact are defined for each impact topic and used in the conclusion to indicate the degree of intensity or diversity of the impact judged from the analysis. The five levels are designated by the following qualitative terms indicating the degree of impact: very high; high; moderate; low; and very low. Definitions of these impact levels for each resource category are provided in Table S-6.

To facilitate the analysis, the Federal offshore area is divided into subplanning areas. The WPA is comprised of three subplanning areas (W-1, W-2, and W-3) and the coastal region is divided into two coastal subareas (W-1 and W-2). These subareas are delineated on Figure IV-1.

(1) Impacts on Sensitive Coastal Habitats

(a) Coastal Barriers

Several impact-producing factors may affect coastal barriers in the Western Gulf as a result of the proposed action.

Oil-spill cleanup operations could result in the removal of large quantities of oiled sand. Sand removal could result in accelerated erosion, particularly along the stretches of eroding beaches that occur along the Texas coast. Because of the very low probability of occurrence and contact from either an offshore (platform blowouts, shuttle tanker accidents, or pipeline accidents) or onshore spill (shuttle tanker or barge spills or pipeline accidents), it is assumed that no contact from a spill will occur. Furthermore, cleanup methods that do not result in the removal of beach sand could be used. The impact level from this factor is considered to be very low.

Impacts from onshore and nearshore construction of OCS-related infrastructure (pipeline landfalls, service bases, platform yards, etc.) are not expected to occur, because no new infrastructure construction is anticipated as a result of the proposed action. The impact level from this factor is considered to be very low.

No new navigation channels are anticipated as a result of the proposed action. Maintenance dredging of existing canals through barrier passes to accommodate vessel traffic to support the proposed action could alter littoral dynamics in the vicinity of the channel and could affect erosion and deposition patterns. Field studies, however, have not substantiated that dredging has resulted in coastal barrier erosion. In fact, the disposal of dredged material into the coastal, littoral transport system can the used to nourish sediment-starved and eroding coastal barriers. The impact level from this factor is considered to be very low.

It follows from the above discussion that activities resulting from the proposed action will not have a significant impact on coastal barriers.

Conclusion

Impacts on coastal barriers as a result of the proposed action in the WPA are expected to be very low.

(b) Wetlands

Several impact-producing factors may threaten coastal wetlands.

Oil spills that contact wetlands can result in the die back of aboveground vegetation and in complete plant mortality if high concentrations of oil persist in the soil. Wetlands in which the vegetation has been killed and weakened by contact with oil will be subject to accelerated shore erosion while the vegetation is recovering. Large oil spills that occur as a result of the proposed action are not assumed to contact coastal wetlands in the WPA. The occurrence and contact from one spill less than or equal to 50 bbl and greater than 1 bbl will not affect marsh vegetation because of the low concentrations of oil that will contact the wetlands.

The dredging of pipeline and navigation canals has both direct and indirect impacts on coastal wetlands. The construction of OCS-related onshore support facilities in wetland areas results in the conversion of wetland habitat to commercial land. No new dredging for pipeline or navigation canals and no new onshore infrastructure construction are anticipated in WPA wetlands as a result of the proposed action.

It follows from the above discussion that activities associated with the proposed action will result in very low impacts to coastal wetlands in the Western Gulf.

Conclusion

The level of impact on coastal wetlands in the WPA resulting from the proposed action is expected to be very low.

(2) Impacts on Sensitive Offshore Habitats and Communities

(a) Deep-water Benthic Communities

The only impact-producing factor threatening the chemosynthetic communities is physical disturbance of the bottom, which would destroy the organisms comprising these communities. Such disturbance would come from those OCS-related activities associated with pipelaying, anchoring, structure emplacement, and seafloor blowouts. Only structure emplacement is considered to be a threat, and then only to the high-density (Bush Hill-type) communities; the widely distributed low-density communities would not be at risk. The provisions of NTL 88-11 (currently in effect), requiring surveys and avoidance prior to drilling, will reduce, but not completely eliminate, the risk.

Conclusion

The level of impact on the localized deep-water benthic communities of the Bush Hill type in the Western Gulf resulting from the proposed action is expected to be moderate. The impact to the widespread low-diversity areas is expected to be low.

(b) Topographic Features

Several impact-producing factors may threaten the communities of the topographic features.

Anchoring of vessels and structure emplacement result in physical disturbance of the benthic environment and are the most likely activities to cause permanent or long-lasting impacts to sensitive offshore habitats. Recovery from damage caused by such activities may take 10 or more years. The impact level from this factor is considered to be very high.

Operational discharges (drilling muds and cuttings, produced waters) may impact the biota of the banks due to turbidity and sedimentation, resulting in death to benthic organisms in large areas. Recovery from such damage may take 10 or more years. The impact level from this factor is considered to be very high.

Blowouts may similarly cause damage to benthic biota by resuspending sediments, causing turbidity and sedimentation, and resulting in death to benthic organisms. Recovery from such damage may take up to 10 years. Fortunately, blowouts are rare in the Gulf. The impact level from this factor is considered to be low.

Oil spills (there is an estimated 7% chance of an oil spill greater than or equal to 1,000 bbl occurring in the Western Gulf as a result of this proposed action) will cause damage to benthic organisms if the oil contacts the organisms; such contact is likely only from spills from blowouts, which are rare in the Gulf. The impact level from this factor is considered to be very low.

Structure removal using explosives (as is generally the case) results in water turbidity, sediment deposition, and potential explosive shock-wave impacts. Severe damage to benthic organisms could result. Recovery from such damage could take more than 10 years. The impact level from this factor is considered to be high.

It follows from the above that activities resulting from this proposal, especially bottom-disturbing activities, have a potential for causing very high impacts to the biota of the topographic features. While some of the activities are expected to result in lower impacts, those having the greatest impacts are also those most likely to occur.

Conclusion

The proposed action is expected to have a very high impact on the sensitive offshore habitats of the topographic features.

(3) Impacts on Water Quality

(a) Coastal and Nearshore

Existing onshore infrastructure and associated coastal activities, occurring in support of Sale 135, will contribute to the degradation of coastal and nearshore water quality in some localized areas to a low extent because onshore facilities and actions discharge a low measure of continuous contamination or experience spills. Onshore discharges or actions affecting coastal and nearshore waters include the following types. Process, cooling, boiler, and sewage water effluents will be discharged due to the 3-4 percent use of the existing 36 gas processing plants, 20 oil refineries, 3 pipe yards, 11 service bases, 14 terminals, and 13 separation facilities in support of the proposed action. These effluents will be mainly concentrated in the Galveston Bay and Corpus Christi areas, resulting in low-level impacts to these areas. Maintenance dredging of existing navigation channels and deepening of others for larger vessel requirements are expected to result in some short-term loss of use of the surrounding waters in localized areas. The 68 shuttle tanker trips and 9,000 service vessel trips are likely to further impact water quality by routine release of bilge and ballast waters (estimated at 2,000 liters per day from service vessels), chronic fuel and tank spills, trash, and low-level releases of the contaminants in antifouling paints. A few oil spills greater than 50 bbl and less than 1,000 bbl will contribute a low-level impact locally near some terminals and service bases where the spills have a probability of occurrence; regionally, impacts from such oil spills will be very low. These oil spills plus chronic oil leakage from both support vessels and coastal facilities are expected to contribute slightly to the total hydrocarbon burden of coastal waters.

The ability of water to assimilate through dilution and biochemical processes is often stressed when there are more than one source or type of contamination. Contamination can be additive so that the level of impact from several concurrent sources is greater than any one source. When examining all of the discharges together, impacts on coastal water quality from OCS oil and gas operations associated with Sale 135 will be low in the Galveston, Corpus Christi, and Port O'Connor areas due to high support vessel traffic and concentrated infrastructure. Regionally, long-term degradation of coastal or nearshore Texas water quality will be negligible, i.e., will be occurring at a very low level as a result of Sale 135.

Conclusion

Impacts from OCS oil and gas operations associated with the proposed action on coastal water quality would be very low, except in the Galveston, Corpus Christi, and Port O'Connor areas where it will be low.

(b) Offshore

Several impact-producing factors may adversely affect offshore water quality.

Resuspension of bottom sediments may result from drilling operations, platform and pipeline installation, and platform removal operations. Some measures of water quality parameters may change from background levels with little effect to the users of the water, and then only very close to the source. The impact level from this factor is considered to be low.

Operational discharges (drilling muds and cuttings, produced waters, deck drainage, and sanitary and domestic wastes) may degrade some measures of water quality, changing them from background levels, but with little effect to the users of the water, and then only very close to the source. The impact level from this factor is considered to be low.

Accidental oil spills (there is an estimated 7% chance of an oil spill greater than or equal to 1,000 bbl occurring in the Western Gulf as a result of this proposed action) may degrade some measures of water quality, changing them from background levels, but with little effect to the users of the water, and then only in a very limited area close to the source. The impact level from this factor is considered to be low.

Activities resulting from this proposal all result in low impacts limited to very close to the source.

Conclusion

As a result of the proposed action, the impact to offshore water quality in the Western Gulf is estimated to be low.

(4) Impacts on Air Quality

Air quality impacts could result from onshore and offshore operational emissions as a result of drilling and production activities. Short-term degradation of air quality due to evaporation could occur as a result of a large oil spill; however, this impact would be localized geographically and would disperse rapidly in time, making the environmental effects negligible. In the Western Gulf, the areas that are classified as nonattainment or PSD Class I and that are adjacent to OCS-related activities are Cameron, Nueces, Galveston, Jefferson, Brazoria, and Harris Counties in Texas. These counties are over 10 mi from the OCS due to the location of the Federal/State line in the WPA. The expected levels of activity adjacent to these counties are not expected to be large due to trends in leasing farther offshore. This trend toward development farther offshore will increase distances to shore, which will result in greater dispersion of emissions, i.e., a very low level of impact. Oil and gas activities on the OCS are not expected to occur simultaneously and are not expected to cause impacts above the level defined as very low. A summary of expected impacts on the air resource is presented in Table IV-35.

Conclusion

Low impacts are expected in Cameron, Nueces, Galveston, Jefferson, and Brazoria Counties, Texas. Very low impacts are expected throughout the remainder of the coastal area of the Western Gulf.

(5) Impacts on Endangered and Threatened Species

(a) Kemp's Ridley Sea Turtle

Several impact-producing factors may have adverse impacts on the Kemp's ridley sea turtle.

Anchoring, pipe and structure emplacement, dredging, produced waters, domestic-sanitary waste and some oil-spill impacts result in disturbance of the seagrasses and benthic fauna utilized by sea turtles. Recovery from damage caused by such activities would take six months to two years. The impact level from this factor is considered low.

The removal of oil and gas structures with explosives could result in shock-wave-related injuries. Sea turtles may be affected several times during the lease. Recovery from such damage could take one generation. The impact level from this factor is considered low.

Vessel traffic associated with the proposed action could collide with or displace sea turtles. Such interactions could cause or be indirectly related to turtle mortality. These interactions are estimated to occur several times during the lease life. Recovery could be accomplished in one generation. The impact level from this factor is considered low.

The entrapment in or ingestion of trash and debris that is generated as a result of the proposed action could cause the drowning or starvation of sea turtles. These interactions are estimated to occur several times during the lease life and result in losses that would require one generation to recover. The impact level from this factor is considered low.

Contact with, ingestion of, or displacement by spilled oil resulting from the proposed action will have adverse impacts on sea turtles. Turtle/oil spill interactions are estimated to be unlikely but could result in losses that would require three or more generations to recover. The impact from this factor is considered moderate.

While the level of impact from the sale-related activities varies, those activities having the greatest impact most accurately represent the effect of the sale on the species because of its limited ability to sustain its population and recover from adverse impacts.

Conclusion

The impact of the Base Case on the Kemp's ridley sea turtle is estimated to be moderate.

(b) Loggerhead Sea Turtle

Several impact-producing factors may have adverse impacts on the loggerhead sea turtle.

Anchoring, pipe and structure emplacement, dredging, produced waters, domestic-sanitary waste, and some oil-spill impacts result in disturbance of the seagrasses and benthic fauna utilized by sea turtles. Recovery from damage caused by such activities would take six months to two years. The impact level from this factor is considered low.

The removal of oil and gas structures with explosives could result in shock-wave-related injuries or displacement from preferred habitats. Sea turtles may be affected several times during the lease. Recovery from such damage could take one generation. The impact level from this factor is considered low.

Vessel traffic associated with the proposed action could collide with or displace sea turtles. Such interactions could cause or be indirectly related to turtle mortality. These interactions are estimated to occur several times during the lease life. Recovery could be accomplished in one generation. The impact level from this factor is considered low.

The entrapment in or ingestion of trash and debris that is generated as a result of the proposed action could cause the drowning or starvation of sea turtles. These interactions are estimated to occur several times during the lease life and result in losses that would require one generation to recover. The impact level from this factor is considered low.

Contact with, ingestion of, or displacement by spilled oil resulting from the proposed action will have adverse impacts on sea turtles. Turtle/oil spill interactions are estimated to be unlikely but could result in losses that would require one to two generations to recover. The impact from this factor is considered low.

While the level of impact from the sale-related activities varies, those activities having the greatest impact most accurately represent the effect of the sale on the species because of its limited ability to sustain its population and recover from adverse impacts.

Conclusion

The impact of the Base Case on the loggerhead sea turtle is estimated to be low.

(c) *Great Whales*

Several impact-producing factors may have adverse impacts on the great whales.

Operational discharges (drilling muds and cuttings) may reduce the whales' food sources by death or displacement resulting from sedimentation, turbidity, or ingestion. Such impacts are unlikely to occur and are primarily sublethal. The impact level of this factor is considered very low.

Vessel traffic associated with the proposed action could collide with or displace whales. Such interactions could cause or be indirectly related to mortality. These interactions are estimated to occur once during the lease life. Recovery could be accomplished in less than one generation. The impact level from this factor is considered very low.

The removal of oil and gas structures with explosives could result in shock-wave-related injuries or displacement from preferred habitats. Whales may be affected once during the lease. Recovery from such damage could take one generation. The impact level from this factor is considered very low.

Explosions during seismic exploration could result in shock-wave-related injuries or displacement from preferred habitats. Whales may be affected several times during the lease. Recovery from such damage could take less than one generation. The impact level from this factor is considered low.

Contact with, ingestion of, or displacement by spilled oil resulting from the proposed action will have adverse impacts on whales. Interactions between oil and whale habitat may occur several times during the lease life, and any resultant declines would be recoverable in one generation. The impact from this factor is considered low.

While the level of impact from the sale-related activities varies, those activities having the greatest impact most accurately represent the effect of the sale on the species because of its limited ability to sustain its population and recover from adverse impact.

Conclusion

The impact of the proposed action on great whales is estimated to be low.

(d) *Piping Plover*

Several impact-producing factors may have adverse impacts on the piping plover.

Pipeline landfalls and onshore construction that may arise as a result of the proposed action may contribute to piping plover mortality by habitat destruction or displacement from preferred habitats. Such impacts are primarily sublethal and are estimated to occur once during the lease life. The impact level from this factor is considered very low.

Contact with, ingestion of, or displacement by spilled oil resulting from the proposed action will have adverse impacts on piping plovers. Interactions between piping plovers and spilled oil are estimated to occur once during the lease life, and resultant population losses would recover within one generation. The impact from this factor is considered low.

While the level of impacts from the sale-related activities varies, those activities having the greatest impacts most accurately represent the effect of the sale on the species because of its limited ability to sustain its population and recover from adverse impacts.

Conclusion

The impact of the proposed sale on piping plovers is estimated to be low.

(e) *Brown Pelican*

Several impact-producing factors may have adverse impacts on the brown pelican.

Pipeline landfalls and onshore construction that may arise as a result of the proposed action may contribute to brown pelican mortality by habitat destruction or displacement from preferred habitats. Such impacts are primarily sublethal and are estimated to occur once during the lease life. The impact level from this factor is considered very low.

Contact with, ingestion of, or displacement by spilled oil resulting from the proposed action will have adverse impacts on brown pelicans. Interactions between brown pelicans and spilled oil are estimated to occur once during the lease life, and resultant population losses would require one to two generations to recover. The impact from this factor is considered low.

Disturbance by sale-related air traffic could alter the normal behavior of brown pelicans or encourage the abandonment of otherwise preferred habitat. These interactions could occur annually, but any mortality would probably recover in less than one generation. The impact from this factor is considered low.

The entrapment in or ingestion of trash and debris that is generated as a result of the proposed action could cause the drowning or starvation of brown pelicans. These interactions are estimated to occur several times during the lease life and result in losses that would require one generation to recover. The impact level from this factor is considered low.

While the level of impacts from the sale-related activities varies, those having the greatest impacts most accurately represent the effect of the sale on the species because of its limited ability to sustain its population and recover from adverse impacts.

Conclusion

The impact of the proposed sale on brown pelicans is estimated to be low.

(f) Eskimo Curlew

Several impact-producing factors may have adverse impacts on the Eskimo curlew.

Onshore maintenance of pipelines or support facilities that may arise as a result of the proposed action may contribute to Eskimo curlew mortality by habitat destruction or displacement from preferred habitats. Interactions are primarily sublethal, but due to the severely depressed population and its limited potential for recovery, any mortality would require three or more generations to recover. Interactions are estimated to occur once during the lease life. The impact level from this factor is considered moderate.

Contact with, ingestion of, or displacement by spilled oil resulting from the proposed action will have adverse impacts on Eskimo curlews. Interactions are estimated to occur once during the lease life, and resultant losses would require three or more generations to recover. The impact from this factor is considered moderate.

While the level of impacts from the sale-related activities varies, those activities having the greatest impacts most accurately represent the effect of the sale on the species because of its limited ability to sustain its population and recover from adverse impacts.

Conclusion

The impact of the proposed sale on the Eskimo curlew is estimated to be moderate.

(g) Whooping Crane

Several impact-producing factors may have adverse impacts on the whooping crane.

Pipeline landfalls and onshore construction that may arise as a result of the proposed action may contribute to whooping crane mortality by habitat destruction or displacement from preferred habitats. Such impacts are primarily sublethal and are estimated to occur once during the lease life. The impact level from this factor is considered very low.

Contact with, ingestion of, or displacement by spilled oil resulting from the proposed action will have adverse impacts on whooping cranes. Spills originating offshore are unlikely to contact whooping cranes or their habitat. Spills occurring in the Intracoastal Waterway resulting from the transport of OCS oil are estimated to occur once during the lease life. The resultant population losses would require three or more generations to recover. The impact from this factor is considered moderate.

Disturbance by sale-related air traffic could alter the normal behavior of whooping cranes or encourage the abandonment of otherwise preferred habitat. These interactions could occur annually, but any mortality would probably recover in less than one generation. The impact from this factor is considered low.

While the level of impacts from the sale-related activities varies, those activities having the greatest impacts most accurately represent the effect of the sale on the species because of its limited ability to sustain its population and recover from adverse impacts.

Conclusion

The impact of the Base Case on whooping cranes is estimated to be moderate.

(6) Impacts on Marine Mammals

Several impact-producing factors may have adverse impacts on the marine mammals.

Operational discharges (drilling muds and cuttings) may reduce the marine mammals' food sources by death or displacement resulting from sedimentation, turbidity, or ingestion. Such impacts are unlikely to occur and are primarily sublethal. The impact level of this factor is considered very low.

Vessel traffic associated with the proposed action could collide with or displace marine mammals. Such interactions could cause or be indirectly related to mortality. These interactions are estimated to occur once during the lease life. Recovery could be accomplished in less than one generation. The impacts level from this factor is considered very low.

The removal of oil and gas structures with explosives, and seismic exploration could result in shock-wave-related injuries. Marine mammals may be affected several times during the lease. Recovery from such damage could take less than one generation. The impact level from this factor is considered low.

Contact with, ingestion of, or displacement by spilled oil resulting from the proposed action will have adverse impacts on marine mammals. Interactions between oil and marine mammal habitat may occur several times during the lease life, and any resultant declines would be recoverable in one generation. The impact from this factor is considered low.

While the level of impacts from the sale-related activities varies, those activities having the greatest impacts most accurately represent the effect of the sale on the species because of its limited ability to sustain its population and recover from adverse impacts.

Conclusion

The impact of the proposed sale on marine mammals is estimated to be low.

(7) Impacts on Coastal and Marine Birds

Several impact-producing factors may threaten coastal and marine birds.

The OCS-related helicopter and service-vessel traffic results in displacement of birds from nesting and feeding habitats. A maximum of 1,000 service-vessel trips and 3 shuttle-tanker trips will occur per year through existing port areas. At worst, the effect of vessel or air traffic during any time of year is of a very short-term nature. The MMS regulates flight elevation to no lower than 2,000 ft during the time of year of greatest concentration of coastal and marine birds (mid-October to mid-April). The impact level from this factor is considered to be very low.

Pipeline landfalls and coastal facility construction results in possible desertion of birds from nesting and feeding habitats. No new OCS-related pipeline landfalls or coastal construction are projected for the proposed action. The impact level from this factor is considered to be very low.

Entanglement or ingestion of OCS-related plastic debris may injure or kill coastal and marine birds. The MMS prohibits the disposal into offshore waters of any OCS-related materials, including plastics. In addition, MARPOL, Annex V, prohibits the disposals of any plastics at sea or in coastal waters. The impact level from this factor is considered to be very low.

Oil spills pose the greatest threat to coastal and marine birds by direct oiling, food source contamination, or nesting habitat pollution. It is assumed that one large oil spill (greater than or equal to 1,000 bbl) will occur during the 39-year lease life. The highest estimated probability of oiling, contamination, or pollution involving coastal and marine birds is 1 percent. The impact level from this factor is considered to be very low.

It follows that activities resulting from the proposed action have the potential to cause very low impacts to coastal and marine birds. There will be no discernible decline in a coastal or marine bird population or species, and no change in distribution or abundance. Any individuals experiencing sublethal effects will recover to pre-impact condition in less than one generation.

Conclusion

A very low level of impact on coastal and marine birds is estimated to occur in the Western Gulf as a result of the Base Case.

(8) Impacts on the Commercial Fishing Industry

Several impact-producing factors may threaten the commercial fishing industry.

The emplacement of one production platform eliminates approximately 3.7 ha (9 ac) of commercial trawling space. Fifteen offshore platform/structures will be constructed, removing 55 ha (135 ac) from commercial trawling. This represents an inconsequential amount of the total trawling area. The impact from this factor is considered to be very low.

Oil spills pose the greatest threat to the commercial fishing industry by direct contact with eggs, larvae, juveniles, or massed spawning adult finfish or shellfish; by contamination of essential estuarine nursery habitat; or by deterrence of commercial fishing activity. It is assumed that one large oil spill (greater than or equal to 1,000 bbl) will occur during the 39-year lease life. The highest estimated probability of contact and affect, contamination, or deterrence involving commercial fishing resources is 1 percent. The impact from this factor is considered to be low.

It follows that activities resulting from the proposed action have the potential to cause low level impacts to the commercial fishing industry. There will be little discernible decline in populations of commercial importance, in the quality of essential habitats, or in commercial fishing activity. Recruitment will return any affected population, habitat, or activity to pre-impact level and/or condition within one generation.

Conclusion

A low level of impact on the commercial fishing industry is estimated to occur in the Western Gulf as a result of the Base Case.

(9) Impacts on Recreational Beach Use

Small oil spills are likely to affect WPA beaches, with little disruption of recreational activities or tourism. Marine debris loss from OCS operations associated with drilling 310 new wells, producing oil and gas from 15 new platforms, and installing and maintaining 121 km of new pipeline throughout the WPA over the next 39 years will occur from time-to-time; however, the severity of impact from intermittent debris washup on Texas beaches should be low.

Conclusion

The proposed action is expected to result in a low impact on recreational beach use and tourism along the Texas coast.

(10) Impacts on Archaeological Resources

(a) Historic

The greatest impact to an historic cultural resource as a result of the proposed action would result from a contact between an OCS offshore activity (platform installation, drilling rig emplacement, and pipeline projects) and an historic shipwreck. The archaeological surveys that are conducted prior to initiating oil and gas activities within a lease block are estimated to be 90 percent effective at locating historic shipwrecks in areas where sidescan sonar is effective at identifying shipwrecks. In areas where side scan sonar is ineffective because of thick accumulations of sediment on the seafloor (these areas roughly account for 50% of the WPA), magnetometer data, which is estimated at being only 25 percent effective at locating ferrous objects from historic shipwrecks at the 150-m line spacing used in the archaeological survey, will be the only means to detect shipwrecks. A recently completed, MMS-funded study (Garrison et al., 1989) has provided new data on shipwreck locations.

Other activities associated with the proposed action are expected to have very low impacts on historic archaeological resources. No new onshore infrastructure construction or pipeline landfalls are expected as a result of the proposed action. Historic cultural resources, therefore, will not be affected by these activities. The chances of contact from an oil spill associated with the proposed action is very low. Furthermore, the impact from an oil-spill contact on an historic coastal site, such as a fort or a lighthouse, would be visual due to oil contamination. These impacts would be temporary and reversible.

To summarize, because of incomplete knowledge on the location of shipwrecks in the Gulf, an OCS activity could contact a shipwreck. Although this occurrence is not probable, such an event would result in the disturbance or destruction of important historic archaeological information. Other factors associated with the proposed action are not expected to affect historic archaeological resources. The impact level of the proposed action is expected to be moderate because of the possibility of a contact between an OCS activity and an historic shipwreck.

Conclusion

The level of impact to historic sites in the Western Gulf as a result of the proposed action is expected to be moderate.

(b) Prehistoric

Several impact-producing factors may threaten the prehistoric archaeological resources of the Western Gulf. An impact could result from a contact between an OCS activity (pipeline and platform installations, drilling rig emplacement and operation, and anchoring activities) and a prehistoric site located on the continental shelf. The archaeological surveys that are required prior to an operator beginning oil and gas activities in a lease block are estimated to be 90 percent effective at identifying possible prehistoric sites. Since the survey provides a significant reduction in the potential for a damaging interaction between an impact-producing factor and a prehistoric site, the impact level from this event is considered to be very low.

Onshore development as a result of the proposed action could result in the direct physical contact between new facility construction, pipeline trenching, and navigation canal dredging. None of these activities are expected to occur under the Base Case. The impact level from these factors is considered to be very low.

Should an oil spill contact a coastal prehistoric site, the potential for dating the site using radiocarbon methods could be destroyed. Previously unrecorded sites could also experience an impact from oil-spill cleanup operations on beaches. The probability of a large spill contacting a coastal prehistoric site is very low (less than 0.5%), and it is assumed that no contact will occur. One spill greater than 1 and less than or equal to 50 bbl is assumed to contact the coast, but this small spill would not cover an exposed site, such as a shell midden, with enough oil to contaminate all the dateable organic remains. The impact level from oil-spill contact is expected to be very low.

Conclusion

The level of impact to prehistoric sites in the Western Gulf as a result of the proposed action is expected to be very low.

c. Potential Mitigating Measures

(1) Topographic-features Stipulation

The topographic features of the Western Gulf provide habitat for coral and coral community organisms (Section III.B.2.). As discussed in Section IV.D.2.a.(2)(b), these communities would be severely and adversely impacted (i.e., have an expected impact level of "very high") by unrestricted oil and gas activities resulting from the proposed action if such activities took place on or near these communities. The DOI has recognized this problem for some years, and since 1974 stipulations have been made a part of leases on blocks on or near these biotic communities so that impacts from nearby oil and gas activities were mitigated to the greatest extent possible. This stipulation would not prevent the recovery of oil and gas resources, but it would serve to protect valuable and sensitive biological resources. The stipulation is presented as an option for the Secretary's consideration.

The Topographic-features Stipulation was formulated based on consultation with various Federal agencies and comments solicited from State, industry, environmental organizations, and academic representatives. The stipulation wording is based on the scientific information collected since the inception of the stipulation. This information includes various Bureau of Land Management/MMS-funded studies on the topographic highs in the Western Gulf, numerous stipulation-imposed, industry-funded monitoring reports, and the National Research Council (NRC) report entitled *Drilling Discharges in the Marine Environment* (1983).

The rationale for the requirements in the stipulation is based on the following facts:

(a) Shunting of the drilling effluent to the nepheloid layer confines the effluent to a level deeper than that of the living reef of a high relief topographic feature. Shunting is therefore an effective measure for protecting the biota of high relief topographic features (Bright and Rezak, 1978; Rezak and Bright, 1981; NRC, 1983).

(b) Biological effect on the benthos from the deposition of unshunted discharge is mostly limited to within 1,000 m of the discharge (NRC, 1983).

(c) The biota of topographic features can be categorized into depth-related zones defined by degree of reef-building activity (Rezak and Bright, 1981; Rezak et al., 1983 and 1985).

The stipulation would establish No Activity Zones at the topographic features. The zone is defined by the 85-m isobath because, generally, the biota shallower than 85 m are more typical of the Caribbean reef biota, while the biota deeper than 85 m are similar to soft-bottom organisms found throughout the Gulf. Where a bank is in water depths less than 85 m, the deepest closing isobath defines the No Activity Zone for that bank. Within the No Activity Zone, no operations, anchoring, or structures would be allowed.

Outside of the No Activity Zones, additional restrictive zones would be established within which oil and gas operations could occur, but within which drilling discharges would be shunted.

The stipulation generally would require that all effluents within 1,000 m of the south Texas banks, which contain the antipatharian-transitional zone, be shunted to within 10 m of the seafloor. The shelf edge banks, which contain the more sensitive and productive algal-sponge zone, would require a shunt zone extending 1 nmi and a 3-nmi shunt zone for development only.

Exceptions to this general stipulation scheme would be made at two classes of banks: the Flower Gardens and the low relief banks. The Flower Gardens, because they contain the northernmost example in the Gulf of living coral reefs and are being considered for National Marine Sanctuary status (Section I.B.4.n.), would be protected to a greater degree than the other banks. The added provisions of the stipulation at the Flower Gardens would be that: (a) the No Activity Zone would be based on the 100-m isobath instead of the 85-m isobath and would be defined by the "1/4 1/4 1/4" system (a method of defining a specific portion of a block) rather than the actual isobath; and (b) there would be a 4-Mile Zone instead of a 1-Mile Zone in which shunting would be required.

The second exception would be for the low relief banks, where shunting is considered counterproductive because it would put the potentially toxic drilling muds in the same water zone as the bank biota that are being protected. Because of their low relief, these banks are adapted to high turbidity. Therefore, these banks would contain only a No Activity Zone. Claypile Bank is a low relief bank that contains the *Millepora*-sponge community. Because of its higher priority it would be given the added protection of a 1,000-Meter Zone in which monitoring would be required. Since shunting would be counterproductive, monitoring was chosen as a means of assuring that effluent discharge within 1,000 m of this high priority, low relief bank would not affect the biota of Claypile Bank.

These are banks that would cause this stipulation to be applied to blocks of the Western Gulf:

Shelf Edge Banks

Bank Name	Isobath (meters)
West Flower Garden Bank[1]	100 (defined by 1/4 1/4 1/4 system)
East Flower Garden Bank[1]	100 (defined by 1/4 1/4 1/4 system)
MacNeil Bank	82
29 Fathom Bank	64
Rankin Bank	85
Geyer Bank	85
Elvers Bank	85
Bright Bank5	85
McGrail Bank[5]	85
Rezak Bank[5]	85
Sidner Bank[5]	85
Parker Bank[5]	85
Stetson Bank	62
Applebaum Bank	85

Low Relief Banks[2]

Bank Name	Isobath (meters)
Mysterious Bank	74, 76, 78, 80, 84 (see leasing map)
Blackfish Ridge	70
Big Dunn Bar	65
Small Dunn Bar	65
32 Fathom Bank	52
Coffee Lump	Various (see leasing map)
Claypile Bank[3]	50

South Texas Banks[4]

Bank Name	Isobath (meters)
Dream Bank	78, 82
Southern Bank	80
Hospital Bank	70
North Hospital Bank	68
Aransas Bank	70
South Baker Bank	70
Baker Bank	70

[1] Flower Garden Banks - In paragraph (c), a 4-Mile Zone rather than a 1-Mile Zone applies.

[2] Low Relief Banks - Only paragraph (a) applies.

[3] Claypile Bank - Paragraphs (a) and (b) apply. In paragraph (b) monitoring of the effluent to determine the affect on the biota of Claypile Bank shall be required rather than shunting.

[4] South Texas Banks - Only paragraphs (a) and (b) apply.

[5] Central Gulf of Mexico banks with a portion of their 1-Mile Zone and/or 3-Mile Zone in the Western Gulf of Mexico.

The stipulation reads as follows:

Topographic Features Stipulation
(Western Planning Area)

(a) No activity including structures, drilling rigs, pipelines, or anchoring will be allowed within the listed isobath (No Activity Zone) of the banks as listed above.

(b) Operations within the area shown as "1,000 Meter Zone" shall be restricted by shunting all drill cuttings and drilling fluids to the bottom through a downpipe that terminates an appropriate distance, but no more than ten meters, from the bottom.

(c) Operations within the area shown as "1 Mile Zone" shall be restricted by shunting all drill cuttings and drilling fluids to the bottom through a downpipe that terminates an appropriate distance, but no more than ten meters, from the bottom. (Where there is a "1 Mile Zone" designated, the 1,000 Meter Zone in paragraph (b) is not designated.)

(d) Operations within the area shown as "3 Mile Zone" shall be restricted by shunting all drill cuttings and drilling fluids from development operations to the bottom through a downpipe that terminates an appropriate distance, but no more than ten meters, from the bottom.

Effect of the Lease Stipulation

The purpose of the stipulation is to protect the biota of the topographic features from adverse effects due to routine oil and gas activities; if adopted, the stipulation would reduce the expected impact level from very high to very low. Such effects include physical damage from anchoring and rig emplacement and potential toxic and smothering effects from muds and cuttings discharges. The Topographic-features Stipulation has been used on leases since 1974 and this experience shows conclusively that the stipulation works to prevent damage to the biota of these banks from routine oil and gas activities. Anchoring on the sensitive portions of the features by the oil and gas industry has been prevented. Monitoring studies conducted as required by the stipulation have demonstrated that the shunting requirements are effective in preventing the muds and cuttings from impacting the biota of the banks. The potential stipulation, if implemented, would continue to protect the biota of the banks, specifically as discussed below.

Mechanical damage resulting from oil and gas operations is probably the single most severe impact to benthic areas. The No Activity Zone designation would completely eliminate this threat from leasing activities. The sensitive biota within the zones would thus be protected.

The stipulation would protect the low relief banks, except Claypile Bank, with only a No Activity Zone. The biota of these banks and the turbidity of the water are such that protective measures for the drilling discharges are not warranted. However, mechanical damage to the banks from drilling and anchoring could significantly impact these resources. The No Activity Zone would protect the banks from these impacts.

The stipulation has an added measure of protection for Claypile Bank, a low relief bank. The stipulation would require a No Activity Zone and a 1,000-Meter Zone in which monitoring would be required. Claypile Bank is the only low-relief bank that is known to be inhabited by the Millepora-sponge community. This assemblage is categorized by Rezak and Bright (1981) as a Category B community, a zone of minor reef-building activity worthy of increased protection. Due to the low relief of the bank (only 5 m), shunting would be counterproductive. Therefore, a 1,000-Meter Zone in which monitoring is required would be imposed. Any impacts from drilling would thereby be documented so that further protective measures could be taken. The categories of Rezak and Bright (1981) and their definitions are:

Category A: zone of major reef-building activity; maximum environmental protection recommended;
Category B: zone of minor reef-building activity; environmental protection recommended;
Category C: zone of negligible reef-building activity, but crustose algae present; environmental protection recommended; and
Category D: zone of no reef-building or crustose algae; protection not recommended.

The stipulation would require that all effluents within 1,000 m of a high relief topographic feature categorized by Rezak and Bright (1981) as a Category C bank be shunted. The banks would be protected from impact from drilling discharges within the 1,000-m zone because the potentially harmful materials in drilling muds are trapped in the bottom boundary layer and do not get upon the bank where the biota of concern are located. Surface drilling discharge at distances greater than 1,000 m from the bank is not expected to impact the biota since effects are limited to 1,000 m.

The stipulation would protect the remaining Category A and B banks with greater restrictions. (Applebaum Bank is categorized as Category C; however, it contains the algal-sponge community which is indicative of Category A banks and is, therefore, stipulated as a Category A bank.) Surface discharge would not be allowed within 1 nmi of these more sensitive banks. Thus, the stipulation would prevent impacts to the biota of these sensitive banks from drilling discharges within 1 nmi. Surface discharges outside of 1 nmi are not expected to impact the biota of the banks, as effects from surface discharges are limited to 1,000 m. However, it is possible that because multiple wells from a single platform (surface location) are typically drilled during development operations extremely small amounts of muds discharged more than 1 nmi from the bank may reach the bank. In order to eliminate the possible cumulative effect of muds discharged from numerous wells outside of 1 nmi, the stipulation would impose a 3-Mile Zone in which shunting of development effluent would be required.

The stipulation would require increased protection to the Flower Gardens out to four miles. Shunting would be required within a 4-Mile Zone. This is a measure proven effective near topographic features.

The stipulation would prevent damage to the biota of the banks from routine oil and gas activities resulting from the proposal. Furthermore, oil and gas resources present near such areas could be recovered. However, the stipulation would not protect the banks from the adverse effects of an accident such as a large blowout on a nearby oil or gas operation.

(2) Archaeological Resource Stipulation

The archaeological survey requirement of the stipulation is proposed for application on all leases that fall within archaeological resources zones 1 and 2. Zone 1 has a high potential for the occurrence of historic shipwrecks and for prehistoric sites. Zone 2 has a high potential only for prehistoric sites. The stipulation serves to reduce the potential for development-related impacts to archaeological sites by requiring remote sensing surveys within archaeological zones 1 and 2 prior to lease development. These surveys, by recording evidence of potential archaeological resource locations, makes avoidance or mitigation of impacts possible. The stipulation is located in Section II.A.1.c.(3) for the Central Gulf. The archaeological resource survey requirement of the stipulation provides the requisite instrument for MMS to evaluate and identify potential archaeological resources on the OCS prior to exploration and development activities. The survey itself, not the stipulation, reduces the probability of impact to archaeological resources as articulated in Section IV.D.2.a.(10).

(3) Military Areas Stipulation

The military areas stipulation for the Western Gulf is identical to the military areas stipulation for the Central Gulf and would apply to all blocks leased within a warning area. The stipulation has been applied to blocks in warning areas in past lease sales in the Western Gulf and is considered by DOI and DOD to be an effective method of mitigating potential multiple-use conflicts. The military stipulation places requirements for liability, electromagnetic emissions, and operational controls on the lessees.

2. Alternative B - Delete Biologically Sensitive Offshore Habitats

This deletion option is offered for the Secretary's consideration to protect valuable offshore biological resources. It affects the biologically sensitive banks (topographic features) of the Western Gulf.

All of the blocks included in the deletion alternative are also the blocks that would be covered by the Topographic-features Stipulation (discussed in Section II.B.1.c.(1)), which can be adopted by the Secretary to protect the biological habitats of these areas. Furthermore, the Secretary could choose to adopt only a part of this alternative, either alone or in conjunction with the proposed biological stipulation, in order to promote the environmental protection policies of the Department.

Description of the Alternative

This deletion alternative would delete the 80 unleased blocks (Figures II-3 and II-4) of the total 200 blocks (these blocks are listed in Appendix A) that are on or near enough to biologically sensitive areas of the topographic features of the WPA so that activities resulting from the proposed action could have a high probability of impacting these biota. These 80 blocks represent about 1.7 percent of the 4,792 blocks to be offered in the Western Gulf.

Impact Analysis

The following analysis is presented to provide an indication of any change in environmental protection provided under Alternative B as compared with the estimated impacts of Alternative A (the proposed action). Descriptions of the environmental resources of the area are provided in Section III of this document and descriptions of the potential impact-producing factors are provided in Section IV.A. Detailed analyses of the estimated impacts of the proposed action are located in Section IV.D.3. Please reference these sections for more detailed information of the resources, impact-producing factors, and estimated impacts discussed below.

Given the size of the area available for lease under Alternative A, it is reasonable to assume that the removal of 1.7 percent of the area probably will not significantly change the projected level of activity (i.e., numbers of wells, platforms, vessel trips, etc. (Table IV-2) projected under that alternative. The only differences are that under Alternative B no activity will take place in the deletion areas. The assumption that the levels of activity for Alternative B are virtually identical to those projected for Alternative A indicates that the impacts expected to result will be very similar to those described under Alternative A (Section IV.D.1.). The areas make up only a small portion of the WPA, and with the exception of topographic features, only contain small amounts, if any, of the resources analyzed in this document. Therefore, the regional impact levels for all resources except topographic features are estimated to be identical to those described under Alternative A. However, there are some localized changes in the impacts as described below.

Coastal Resources

The coastal environments of the WPA include beaches, seagrass beds, salt and fresh marshes, and estuaries. The beaches serve as important recreational sites in addition to storm protection and erosion control areas. The marshes and estuaries support numerous commercially and recreationally important fishery and wildlife species. The primary impact-producing factors of concern for these environmental resources are contact by oil spills and disturbance from the emplacement of pipelines or the dredging of channels.

The areas that would be deleted from the proposed sale with the selection of Alternative B are scattered across the shelf of the WPA far from the coastline. A small percentage of the area available for deletion is located, at its closest point, about 56 km (35 mi) offshore. The majority of the acreage that may be deleted is over 160 km (100 mi) offshore. Considering the assumption that the estimated level of activity will not change from that projected for Alternative A and the substantial distances from the deletion areass to coastal resources, it is extremely unlikely that selection of Alternative B would have any influence on the impacts estimated for Alternative A.

Conclusion

The impacts on the following coastal resources are estimated to be the same as those estimated under Alternative A: coastal barriers (very low); wetlands (very low); coastal and nearshore water quality (very low); air quality (very low); the federally protected piping plover (low); brown pelican (low); Eskimo curlew (moderate); whooping crane (moderate); coastal and marine birds (very low); and recreational beach use (low).

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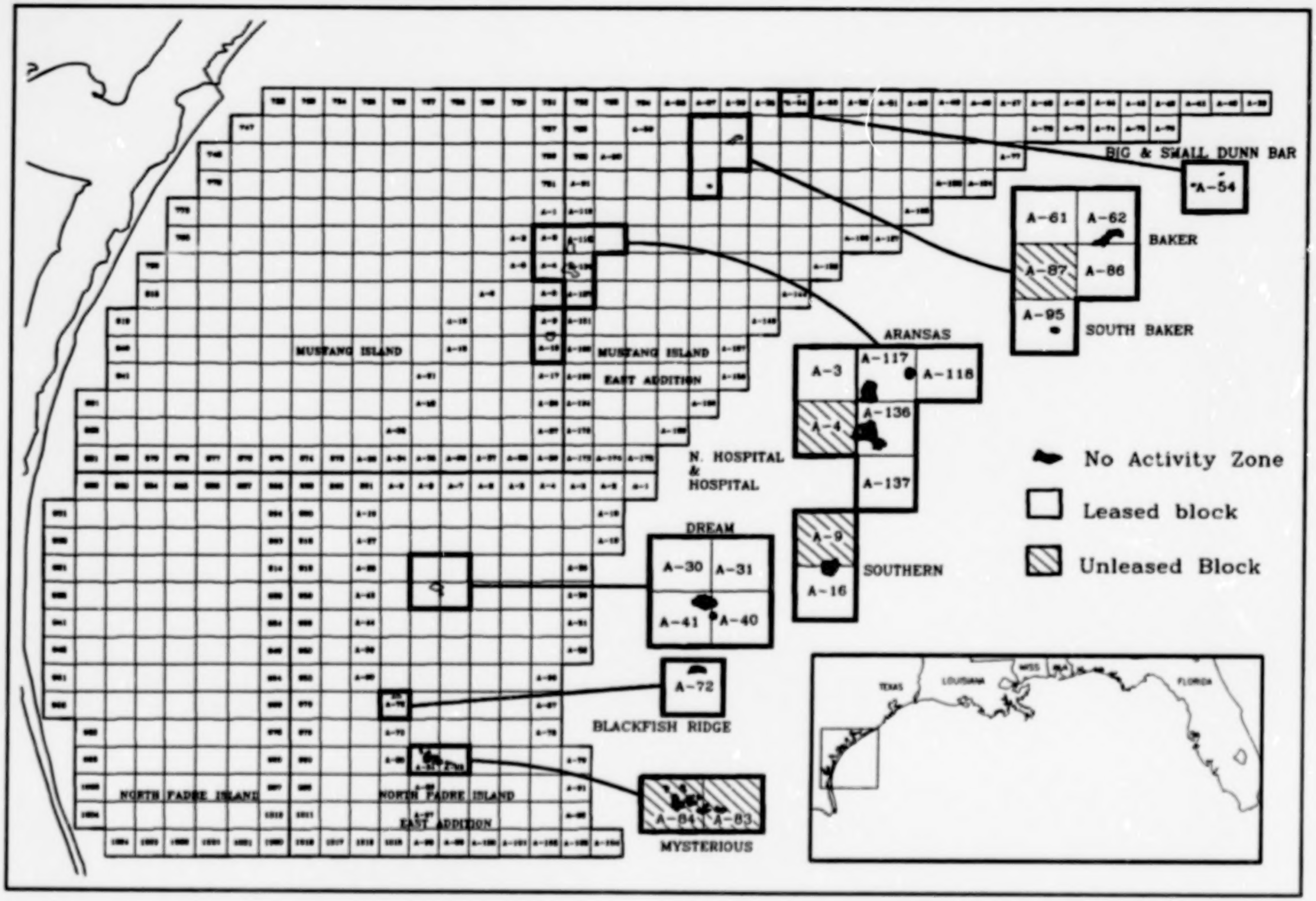

Figure II-3. Location and Lease Status of Blocks Affected by Alternative B (South Texas).

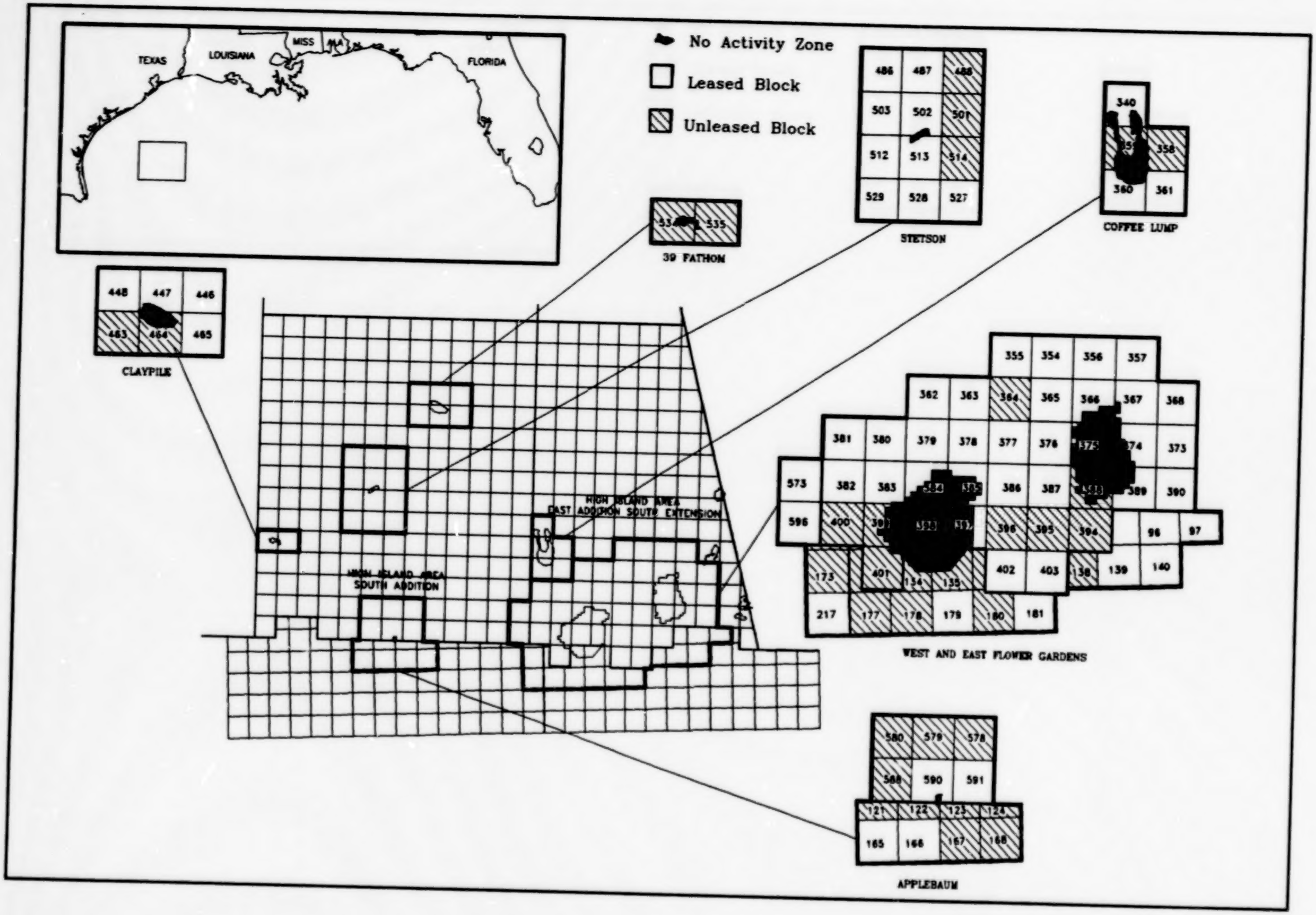

Figure II-4. Location and Lease Status of Blocks Affected by Alternative B (North Texas).

Offshore Resources

Deletion of this area would preclude drilling operations and associated activities from occurring within the affected blocks. It would further eliminate the threat of damage from drilling discharges, anchoring, or platform/pipeline emplacement related to the exploration and development of this area. The following analyses deal specifically with the sensitive resources that may exist in the deletion area and for which there might be a change in impacts with the selection of Alternative B. Deep-water benthic communities and archaeological resources are not located in or near the area, so there would be no change in the impact level projected under Alternative A. Those levels are as follows: deep-water benthic communities (low density, low; high density, moderate) and archaeological resources (historic, moderate; prehistoric, very low).

Topographic Features

Essentially, oil and gas operations within certain distances of topographic features are considered potential sources of impact to the biota of those features: blocks that fall within 4 nmi of the 100-m isobath of the East and West Flower Garden Banks; within 3 nmi of the 85-m isobath of the seven high-relief, shelf edge banks of the Western Gulf (and 5 banks of the Central Gulf that are within 3 nmi of the Western Gulf); within 1,000 m of seven low-relief South Texas banks; and within designated areas of seven other low-relief banks. The biological resources of the topographic features are considered very sensitive to potential impacts due to oil and gas operations; however, topographic features in the Western Gulf are usually the surface expressions of salt domes, which are often associated with oil and gas reserves. The recovery of such reserves, the extent of which is unknown at this time, would be prevented by the adoption of this alternative. However, it is noted that 120 of the 200 blocks affected are already leased. This deletion alternative is presented in order to fully protect the biological resources inhabiting the crests of the topographic features.

This deletion, if adopted, would prevent any oil and gas activity whatsoever in the affected blocks (except for pipeline construction, which would be regulated through the normal pipeline permitting procedures); thus, it would eliminate any impacts to the biota of the area from oil and gas activities which otherwise would be conducted within the blocks. Deleting this small percentage of the Western Gulf area would result in a very large reduction of the potential impacts to these high-value biological resources as compared with Alternative A.

Conclusion

Selection of Alternative B would reduce the impacts to the biota of the topographic features to very low (from the very high of Alternative A).

Offshore Water Quality

The impact-producing factors leading to water quality degradation resulting from offshore OCS oil and gas operations include the resuspension of bottom sediments through exploration and development activities, pipeline construction, and platform removal operations; the discharge of deck drainage, sanitary and domestic wastes, formation waters (produced waters), and drilling fluids (muds and cuttings); and accidental hydrocarbon discharges due to spills, blowouts, or pipeline leaks. All of these factors, except the last, impact only very small areas near the source and for only a short time; the last factor is estimated to be very unlikely to occur. Thus, adoption of this alternative would completely eliminate all but the last factor as a threat to the water quality of the area. However, because the area is a small portion of the entire area offered for leasing, the regional impact level will be reduced by only that small amount, assuming that oil and gas activities would be reduced proportionally.

Conclusion

Selection of Alternative B would eliminate potential impacts on very localized areas contained in the deletion area, but this would not be significant enough to change the regional impact level on offshore water quality as projected under Alternative A (low).

Endangered and Threatened Species and Marine Mammals

Subadult and adult loggerhead, green, hawksbill, and Kemp's ridley sea turtles are unlikely to occur in the proposed deletion area because the topographic features in the CPA and WPA are at depths in excess of the preferred habitat for these species and life stages. However, their hatchlings and leatherback sea turtles could occur in the vicinity of any of these areas. Sperm whales have been sighted near topographic features in the WPA and several of the more common small cetaceans--*Stenella, Kogia,* and *Grampus*--could be expected in the vicinity of topographic features because of the presence of prey species. Sea turtles and marine mammals could be impacted by oil and gas activities in this area by contact with or ingestion of oil, collision with vessels, entanglement in or ingestion of debris generated from platforms, or physical/acoustic disturbances (drilling, structure placement and removal). Deletion of this area from the sale would eliminate all impacts to sea turtles and marine mammals that would occur from proposed action-related oil and gas operations within the deletion area. If the area is not deleted from the proposed sale, impacts to marine mammals and sea turtles will not change significantly from those of the proposed action because of the low level of oil and gas activity proposed and the small number of marine mammals and sea turtles in the area. To the extent that they are present in this small portion of the WPA, regional impacts to these species will be reduced by that same small amount.

Conclusion

Selection of Alternative B would reduce potential impacts on endangered species and marine mammals in and near the deletion area, but the regional reduction would not be significant enough to change the regional impact level on these resources as projected under Alternative A: Kemp's ridley sea turtle (moderate); loggerhead sea turtle (low); great whales (low); and marine mammals (low).

3. Alternative C - No Action

Description of the Alternative

The alternative is equivalent to cancellation of a sale scheduled for a specific timeframe on the approved 5-year OCS Oil and Gas Leasing Schedule. Sales in the Western Gulf are scheduled on an annual basis. By canceling the proposed sale, the opportunity is postponed or foregone for development of the estimated 0.05 BBO and 0.72 tcf of gas that could have resulted from Proposed Sale 135 in the Western Gulf.

Effects of the Alternative

If Alternative C is selected, all impacts, positive and negative, associated with the proposed action would be canceled. This alternative would therefore result in no effect on the sensitive resources and activities discussed in Section IV.D.2.a. The incremental contribution of the proposed action to cumulative effects would also be foregone, but such effects from other activities, including other OCS sales, would remain. One contribution to cumulative effects that could increase is oil-spill risk due to the importation of foreign oil to replace the resources lost through cancellation of the proposed action.

Alternative energy strategies that could provide replacement resources for lost domestic OCS oil and gas production include energy conservation; conventional oil and gas supplies; coal; nuclear power; oil shale; tar sands; hydroelectric power; solar and geothermal energy; and imports of oil, natural gas, and LNG. These are discussed in some detail in Appendix F. The energy equivalents that may be required from several alternative energy sources, should this lease sale be permanently cancelled, are shown on Table F-10 and are based on the resources estimated by MMS to be produced as a result of the proposed action. For the purpose of clarity, this table has separately identified each potential alternative source of energy regarding substitution requirements. It is unlikely, however, that there would be a single choice between these alternatives sources, but instead, some combined effort to explore and develop further many or all of these forms as a substitute for OCS oil and gas production.

4. Comparison of Alternatives

Table S-4 provides a comparison and summary of the impact levels of the proposed action (Alternative A), delete biologically sensitive offshore habitats (Alternative B), no action (Alternative C), and the cumulative analyses for Sale 135. The definitions of the levels of impact used are in Table S-6.

Alternative A (the Proposed Action, Base Case) has the potential to result in low to very low impacts to a majority of the resources analyzed, with the exceptions being air quality, deep-water benthic communities, and high topographic features. The level of impact on deep-water benthic communities (high density) and air quality is estimated to be moderate; whereas, the level of impact on high topographic features is very high. Although the level of impact for historic archaeological resources is anticipated to be very low in coastal subplanning area W-2, the level of impact for subplanning areas W-1 and W-3 is uncertain and may be very high. The biological and archaeological stipulations are being considered for adoption as mitigating measures. If the potential stipulations are utilized, the level of impact to biological resources would be reduced to very low; however, the level of impact for archaeological resources would remain the same as without the stipulation. One exception is historic shipwrecks in the western portion of the Western Gulf where the level of impact is uncertain but could be very high.

Alternative B (Delete Biologically Sensitive Offshore Habitats) would significantly reduce impacts to topographic features and would have the same levels of impact as Alternative A for the remainder of the resource categories listed in Table S-4.

Alternative C (No Action) equates to cancellation of the sale and would preclude any impacts to the resource categories listed in Table S-4 from the proposed action or other alternatives.

C. PROPOSED EASTERN GULF SALE 137

1. Alternative A - The Proposed Action

a. Description

Proposed Eastern Gulf Sale 137 is scheduled to be held in November 1991 and will offer approximately 8,356 unleased blocks (as of June 1990) comprising about 47.5 million acres in the EPA. The actual number of blocks offered for lease will differ from this figure by the number of blocks relinquished, canceled, and terminated. The sale area is located from 16 to 83 km offshore in water depths ranging from 10 to over 3,400 m. Excluded from this proposed action are the area approximately 32-48 km seaward of the western coastline of Florida, extending from the Apalachicola/Cape San Blas area on the north to latitude 26°N to the south, as well as 23 blocks centered around the Florida Middle Ground (both deferred at the time of the 5-Year Program Decision), and the region south of latitude 26°N to the State waters north of the Keys and west to approximately longitude 86°W. These regions have been deferred because of the environmentally sensitive nature of the biological communities located in the blocks. There are also alternatives to the proposed action and protective mitigating measures available for adoption. The alternatives are to delete the Inner Cape San Blas blocks, delete the U.S. Navy's carrier operation area, delete the U.S. Air Force's drone runway area, delete the Panhandle buffer zone, delay the sale, and take no action (cancel the sale). The potential mitigating measures proposed are protection of biological resources (live bottoms), protection of archaeological resources, mitigation of conflicts with military activities, and two separate sets of requirements for certain oil spill response capabilities in two areas off the Florida panhandle.

The analyses of impacts summarized below (Section II.C.1.b.) and described in detail in Section IV.D.3.a. are based on a development scenario (Base Case) formulated to provide a set of assumptions and estimates on the amounts, locations, and timing for OCS exploration, development, and production operations and facilities, both offshore and onshore. These are estimates only and not predictions of what will happen as a result of holding this proposed sale. Tables IV-3, IV-4, and IV-8 through IV-10 summarize major elements of the development scenario and related impact-producing factors for the proposed action. A detailed discussion of the development scenario and major related impact-producing factors is included in Section IV.A. The following major assumptions and estimates are included in the Base Case.

- The discovery and production of 0.04 BBO and 0.06 tcf of gas during the period 1998-2029.

- The drilling of 90 exploration and delineation wells during the period 1995-2002.

- The installation of 10 production platforms and the drilling of 50 development wells during the period 1998-2020.

- Oil and gas production beginning in 1998 and reaching peak annual production during the period 2011-2014 for gas (2.9 bcf/year) and during the period 2011-2012 for oil (2.0 MMbbl/year).

- Estimated drilling mud solid discharges of 637,000 bbl and estimated drill cutting discharges of 72,000 cubic yards.

- All gas production will be transported by pipeline to onshore processing facilities in the Central coastal area (possibly in coastal analysis area C-4). About 82.6 percent of oil production will be transported via 99 shuttle tanker trips to existing port/terminal facilities in the Central coastal area (to Mississippi River ports in coastal analysis area C-3, or to the Mobile/Pascagoula refineries in coastal analysis area C-4). Some oil production (up to 17.4%) would be carried to terminal facilities in the Central coastal area (coastal analysis area C-4) by existing pipelines offshore of the Florida Panhandle.

- The construction of 80 km of offshore pipelines.

- Though the probability of a large oil spill occurring in the EPA is so small (5%) that such an event is unlikely, the occurrence of one spill of approximately 15,400 bbl is assumed for analytical purposes.

- Onshore support, transportation, and processing are expected to be provided entirely from facilities (primarily in the Central and Eastern coastal areas) existing prior to the proposed action or from facilities constructed subsequent to the proposed action as a result of cumulative oil and gas activity (Federal OCS and other) occurring subsequent to the proposed action. No major facility construction is expected to occur solely as a result of the proposed action.

b. Summary of Impacts

The following are summaries of the detailed impact analyses which are included in Section IV.D.3.a. It is noted that these summaries are limited to the impact of the proposed action alone (under the Base Case); the cumulative impacts which are assessed in Section IV.D.3.a. are not summarized here. Table S-5 indicates the level of impact on each resource category estimated as a result of the cumulative factors.

Five levels of impact are defined for each impact topic and used in the conclusion to indicate the degree of intensity or severity of the impact judged from the analysis. The five levels are designated by the following qualitative terms indicating the degree of impact: very high; high; moderate; low; and very low. Definitions of these impact levels for each resource category are provided in Table S-6.

To facilitate the analysis, the Federal offshore area is divided into subplanning areas. The EPA is comprised of five subplanning areas (E-1, E-2, E-3, E-4, and E-5) and the Eastern coastal region is divided into four coastal subareas (E-1, E-2, E-3, and E-4). These subareas are delineated on Figure IV-1.

(1) Impacts on Sensitive Coastal Habitats

(a) Coastal Barriers

Several impact-producing factors may threaten the coastal barriers of the Eastern Gulf.

Oil-spill cleanup operations could result in the removal of large quantities of oiled sand. Sand removal could result in accelerated erosion, particularly along the stretches of eroding beaches that occur along the Florida coast. Because of the very low probability of occurrence and contact from an offshore (platform blowouts or shuttle tanker accidents) spill, however, it is assumed that no contact from a spill will occur. Furthermore, cleanup methods that do not result in the removal of beach sand could be used. The impact level from this factor is considered to be very low.

Impacts from onshore and nearshore construction of OCS-related infrastructure (pipeline landfalls, service bases, platform yards, etc.) are not expected to occur because no new infrastructure construction is anticipated as a result of the proposed action. The impact level from this factor is considered to be very low.

No new navigation channels are anticipated as a result of the proposed action. Maintenance dredging of existing canals through barrier passes to accommodate vessel traffic to support the proposed action could alter littoral dynamics in the vicinity of the channel and affect erosion and deposition patterns. Field studies, however, have not substantiated that dredging has resulted in coastal barrier erosion. In fact, the disposal of dredged material into the coastal littoral transport system can be used to nourish sediment-starved and eroding coastal barriers. The impact level from this factor is considered to be very low.

It follows from the above discussion that activities resulting from the proposed action will not have a significant impact on coastal barriers.

Conclusion

The impacts of the proposed action on coastal barriers in the EPA are expected to be very low.

(b) Wetlands

Several impact-producing factors may threaten coastal wetlands (marshes and mangroves) in the EPA.

Although mangroves and marshes are susceptible to both short-term (1 year or less) and long-term damage from oil-spill contacts, no oil spills as a result of the proposed action are expected to contact these habitats. The impact level from this factor is expected to be very low.

No pipeline landfalls, onshore infrastructure construction, or navigation channel projects are projected under the Base Case (Table IV-9). Vessel traffic that is OCS-related will make minimal use of existing navigation channels. Impacts to surrounding wetlands from boat wake erosion and dredge spoil disposal associated with the proposed action will be minor.

It follows from the above discussion that the level of impact to coastal wetlands expected to occur as a result of the Base Case scenario will be very low.

Conclusion

The level of impact to mangroves and coastal marshes in the EPA under the Base Case will be very low.

(c) Seagrasses

Several impact-producing factors that have the potential to impact seagrass beds and the associated organisms have been identified. These include mechanical impacts from anchoring, structure emplacement and removal, pipeline emplacement, blowouts, operational discharges, and oil spills.

The highly productive and plush inshore seagrass beds are protected from direct mechanical damage from those factors listed above due to the establishment of the 32- to 48-km (20- to 30-mi) nearshore buffer zone and to the deferral of the region south of latitude 26°N. These areas are also judged to have a very low potential for impacts from oil spills. The low-productivity seagrass in water depths greater than 20 m has a restricted distribution, strong seasonality, and good recovery potential. Mechanical impacts from structure emplacement, anchoring, and produced-water discharges are highly localized and will have very low impacts.

The discharge of drill cuttings and muds and platform removal impacts are low. The potential for impact to seagrass communities from oil spills is very low.

It is estimated that OCS-related activities will rarely result in changes to the regional health and distribution of the seagrasses and associated organisms. This is largely due to the limited distribution and depth of the resources in the offshore waters of the West Florida shelf and to the limited number of activities in seagrass regions. These changes will be such that they would result in few losses of system elements, general relationships will not be permanently altered, and the time period of disturbance will be 6 months to 2 years.

Conclusion

Activities resulting from the proposed action are expected to have a low impact on the offshore seagrasses of the Eastern Gulf.

(2) Impacts on Sensitive Offshore Habitats and Communities

(a) Live Bottoms

Oil spills may occur at the surface due to tanker spillage or at the seafloor due to pipeline rupture or well blowout. Surface spills could result in a steady discharge of oil over a long period of time. These types of accidents are rare in the Gulf. The frequency of this impacting the live-bottom communities is estimated to be rare. The impact level is judged to be moderate. Pipeline emplacement activities and structure emplacement (pipeline, drilling rig, or platform emplacement) result in physical disturbance of the benthic environment. These activities are routine operations of oil and gas exploration and development and are unavoidable in the absence of the biological stipulation. The frequency of oil spills impacting the live-bottom communities is estimated to be occasional. The impact level is judged to be moderate. Drilling mud and cutting discharges result in localized water turbidity, deposition on the surrounding seafloor, and potential effects of the low concentrations of toxic constituents. Drilling discharge is also a routine operation in exploration and production activity. The frequency of this impacting the live-bottom communities is estimated to be occasional. The impact level is estimated to be low. Produced waters are discharged as a result of drilling and production activities. The frequency of this discharge having an impact on the live bottoms is estimated to be rare, and the impact level is very low. Platform removal may result in turbidity, sediment deposition, bottom disturbance, and shock wave associated impacts (from explosive removal). The frequency of this impacting the live-bottom communities is estimated to be occasional, and the impact level is judged to be low.

Conclusion

Activities resulting from the proposed action are estimated to have a moderate impact on the live bottoms of the Eastern Gulf.

(b) Deep-water Benthic Communities

The only impact-producing factor threatening the chemosynthetic communities is physical disturbance of the bottom, which would destroy the organisms comprising these communities. Such disturbance would come from those OCS-related activities associated with pipelaying, anchoring, structure emplacement, and seafloor blowouts. Only structure emplacement is considered to be a threat, and then only to the high-density (Bush Hill-type) communities; the widely distributed low-density communities would not be at risk. The provisions of NTL 88-11 (currently in effect), requiring surveys and avoidance prior to drilling, will reduce, but not completely eliminate, the risk.

Conclusion

The level of impact on the localized deep-water benthic communities of the Bush Hill type in the Eastern Gulf resulting from the proposed action is expected to be moderate. The impact to the widespread low-diversity areas and those of the Florida escarpment is expected to be low.

(3) Impacts on Water Quality

(a) Coastal and Nearshore

Chronic spills and low-level point and nonpoint source pollution occurring from effluent discharges at the three service bases, service vessel bilge water discharges (estimated at only 433 liters per day), shuttle tanker discharges, and shoreline alteration are each expected to result in a very low impact on the Florida coastal and nearshore water quality. The ability of water to assimilate through dilution and biochemical processes can be stressed when there is more than one source or type of contamination. In particular, the areas around the service bases will receive contamination from bilge waters, antifouling paint components, chronic small spills of diesel oil and oil field supplies, and some maintenance dredging occurring partially to support the bases. Therefore, low-level localized impacts are expected to occur near Panama City, Tampa, and Ft. Myers when all activities are examined together, that is, there will be some disturbance of water quality characteristics related to this sale, and moderate at Port Manatee. However, uses of these waters (Class II and III) will not be altered, and recovery will occur after the proposed action activities end. Regionally, long-term degradation of coastal or nearshore Florida water quality will not occur due to Sale 137, that is, impacts will be very low.

Conclusion

Impacts from OCS oil and gas operations associated with the proposed action on coastal water quality are expected to be low in a few locations along the coast, but will be very low regionally.

(b) Offshore

Several impact-producing factors may adversely affect offshore water quality.

Resuspension of bottom sediments may result from drilling operations, platform and pipeline installation, and platform removal operations. Some measures of water quality parameters may change from background levels with little effect to the users of the water, and then only very close to the source. The impact level from this factor is considered to be low.

Operational discharges (drilling muds and cuttings, produced waters, deck drainage, and sanitary and domestic wastes) may degrade some measures of water quality, changing them from background levels, but with little effect to the users of the water, and then only very close to the source. The impact level from this factor is considered to be low.

Accidental oil spills (there is an estimated 5% chance of an oil spill greater than or equal to 1,000 bbl occurring in the Eastern Gulf as a result of this proposed action) may degrade some measures of water quality, changing them from background levels, but with little effect to the users of the water, and then only in a very limited area close to the source. The impact level from this factor is considered to be low.

Activities resulting from this proposal all result in low impacts limited to very close to the source.

Conclusion

As a result of the proposed action, the impact to offshore water quality in the Eastern Gulf is estimated to be low.

(4) Impacts on Air Quality

Air quality degradation may occur from onshore and offshore operational emissions as a result of drilling and production activities. Short-term degradation of air quality could occur as a result of a large oil spill; however, this impact would be localized geographically and would disperse rapidly in time, making the environmental effects negligible. Adverse impacts to coastal air quality in all but Escambia County is not expected due to the 32- to 48-km (20- to 30-mi) deferral measured from the three league State/Federal line and to the deferral of all blocks south of latitude 26°N in the EPA. The level of new offshore activities adjacent to the shore is expected to be very low due to distance to shore relationships. Increased distances to shore will result in a greater dispersion of emissions, that is, a very low level of severity. A summary of expected impacts on the air resource is presented in Table IV-39.

Conclusion

The impact on coastal air quality is estimated to be moderate in Escambia County; low in Hillsborough, Pinellas, Hernando, Wakulla, and Jefferson County; and very low in Monroe and Dade Counties and throughout the remainder of the coastal areas in the Eastern Gulf.

(5) Impacts on Endangered and Threatened Species

(a) Kemp's Ridley Sea Turtle

Several impact-producing factors may have adverse impacts on the Kemp's ridley sea turtle.

Anchoring, pipe and structure emplacement, dredging, produced waters, domestic-sanitary waste, and some oil-spill impacts result in disturbance of the seagrasses and benthic fauna utilized by sea turtles. Recovery from damage caused by such activities would take six months to two years. The impact level from this factor is considered low.

The removal of oil and gas structures with explosives could result in shock-wave-related injuries. Sea turtles may be affected several times during the lease. Recovery from such damage could take one generation. The impact level from this factor is considered low.

Vessel traffic associated with the proposed action could collide with or displace sea turtles. Such interactions could cause or be indirectly related to turtle mortality. These interactions are estimated to occur several times during the lease life. Recovery could be accomplished in one generation. The impact level from this factor is considered low.

The entrapment in or ingestion of trash and debris that is generated as a result of the proposed action could cause the drowning or starvation of sea turtles. These interactions are estimated to occur several times during the lease life and result in losses that would require one generation to recover. The impact level from this factor is considered low.

Contact with, ingestion of, or displacement by spilled oil resulting from the proposed action will have adverse impacts on sea turtles. Turtle/oil spill interactions are estimated to be unlikely but could result in losses that would require three or more generations to recover. The impact from this factor is considered moderate.

While the level of impact from the sale-related activities varies, those activities having the greatest impact most accurately represent the effect of the sale on the species because of its limited ability to sustain its population and recover from adverse impacts.

Conclusion

The impact of the Base Case on the Kemp's ridley sea turtle is estimated to be moderate

(b) Loggerhead Sea Turtle

Several impact-producing factors may have adverse impacts on the loggerhead sea turtle.

Anchoring, pipe and structure emplacement, dredging, produced waters, domestic-sanitary waste, and some oil-spill impacts result in disturbance of the seagrasses and benthic fauna utilized by sea turtles. Recovery from damage caused by such activities would take six months to two years. The impact level from this factor is considered low.

The removal of oil and gas structures with explosives could result in shock-wave-related injuries or displacement from preferred habitats. Sea turtles may be affected several times during the lease. Recovery from such damage could take one generation. The impact level from this factor is considered low.

Vessel traffic associated with the proposed action could collide with or displace sea turtles. Such interactions could cause or be indirectly related to turtle mortality. These interactions are estimated to occur several times during the lease life. Recovery could be accomplished in one generation. The impact level from this factor is considered low.

The entrapment in or ingestion of trash and debris that is generated as a result of the proposed action could cause the drowning or starvation of sea turtles. These interactions are estimated to occur several times during the lease life and result in losses that would require one generation to recover. The impact level from this factor is considered low.

Contact with, ingestion of, or displacement by spilled oil resulting from the proposed action will have adverse impacts on sea turtles. Turtle/oil spill interactions are estimated to be unlikely but could result in losses that would require one to two generations to recover. The impact from this factor is considered low.

While the level of impact from the sale-related activities varies, those activities having the greatest impact most accurately represent the effect of the sale on the species because of its limited ability to sustain its population and recover from adverse impacts.

Conclusion

The impact of the Base Case on the loggerhead sea turtle is estimated to be low.

(c) Great Whales

Several impact-producing factors may have adverse impacts on the great whales.

Operational discharges (drilling muds and cuttings) may reduce the whales' food sources by death or displacement resulting from sedimentation, turbidity, or ingestion. Such impacts are unlikely to occur and are primarily sublethal. The impact level of this factor is considered very low.

Vessel traffic associated with the proposed action could collide with or displace whales. Such interactions could cause or be indirectly related to mortality. These interactions are estimated to occur once during the lease life. Recovery could be accomplished in less than one generation. The impact level from this factor is considered very low.

The removal of oil and gas structures with explosives could result in shock-wave-related injuries or displacement from preferred habitats. Whales may be affected once during the lease. Recovery from such damage could take one generation. The impact level from this factor is considered very low.

Explosions during seismic exploration could result in shock-wave-related injuries or displacement from preferred habitats. Whales may be affected several times during the lease. Recovery from such damage could take less than one generation. The impact level from this factor is considered low.

Contact with, ingestion of, or displacement by spilled oil resulting from the proposed action will have adverse impacts on whales. Interactions between oil and whale habitat may occur several times during the lease life, and any resultant declines would be recoverable in one generation. The impact from this factor is considered low.

While the level of impact from the sale-related activities varies, those activities having the greatest impact most accurately represent the effect of the sale on the species because of its limited ability to sustain its population and recover from adverse impacts.

Conclusion

The impact of the proposed action on great whales is estimated to be low.

(d) Piping Plover

Several impact-producing factors may have adverse impacts on the piping plover.

Pipeline landfalls and onshore construction that may arise as a result of the proposed action may contribute to piping plover mortality by habitat destruction or displacement from preferred habitats. Such impacts are primarily sublethal and are estimated to occur once during the lease life. The impact level from this factor is considered very low.

Contact with, ingestion of, or displacement by spilled oil resulting from the proposed action will have adverse impacts on piping plovers. Interactions between piping plovers and spilled oil are estimated to occur once during the lease life, and resultant losses would recover within one generation. The impact from this factor is considered low.

While the level of impacts from the sale-related activities varies, those activities having the greatest impacts most accurately represent the effect of the sale on the species because of its limited ability to sustain its population and recover from adverse impacts.

Conclusion

The impact of the proposed sale on the piping plover is low.

(e) Florida Manatee

Several impact-producing factors may have adverse impacts on the Florida manatee.

Anchoring, pipe and structure emplacement, dredging, produced waters, domestic-sanitary waste, and some oil-spill impacts result in disturbance of the sea grasses utilized by the Florida manatee. Recovery from damage caused by such activities would take six months to two years. The impact level from this factor is considered low.

Contact with, ingestion of, or displacement by spilled oil resulting from the proposed action could have adverse impacts on manatees. Interactions are estimated to be unlikely but could result in losses that would require one or two generations to recover. The impact from this factor is considered low.

Vessel traffic associated with the proposed action could collide with or displace manatees. Such interactions could cause or be indirectly related to their mortality. These interactions are estimated to occur once during the lease life. Recovery could be accomplished in two to three generations. The impact level from this factor is considered moderate.

The entrapment in or ingestion of trash and debris that is generated as a result of the proposed action could cause the drowning or starvation of manatees. These interactions are estimated to occur once during the lease life and result in losses that would require one generation to recover. The impact level from this factor is considered very low.

While the level of impacts from the sale-related activities varies, those activities having the greatest impacts most accurately represent the effect of the sale on the species because of its limited ability to sustain its population and recover from adverse impacts.

Conclusion

The proposed sale is estimated to have a moderate impact on Florida manatees.

(f) Gulf Sturgeon

Operational discharges (drilling muds and cuttings) may reduce the Gulf sturgeon's food sources by death or displacement resulting from sedimentation, turbidity, or ingestion. Such interactions could occur once during the lease life and could result in a population decline that would take one to two generations to recover. The impact level of this factor is considered low.

While the level of impacts from the sale-related activities varies, those activities having the greatest impacts most accurately represent the effect of the sale on the species because of its limited ability to sustain its population and recover from adverse impacts.

Conclusion

The impact of the Base Case scenario on the Gulf sturgeon is estimated to be low.

(6) Impacts on Marine Mammals

Several impact-producing factors may have adverse impacts on the marine mammals.

Operational discharges (drilling muds and cuttings) may reduce the marine mammals' food sources by death or displacement resulting from sedimentation, turbidity, or ingestion. Such impacts are unlikely to occur and are primarily sublethal. The impact level of this factor is considered very low.

Vessel traffic associated with the proposed action could collide with or displace marine mammals. Such interactions could cause or be indirectly related to mortality. These interactions are estimated to occur once during the lease life. Recovery could be accomplished in less than one generation. The impact level from this factor is considered very low.

The removal of oil and gas structures with explosives, and seismic exploration could result in shock-wave-related injuries. Marine mammals may be affected several times during the lease. Recovery from such damage could take less than one generation. The impact level from this factor is considered low.

Contact with, ingestion of, or displacement by spilled oil resulting from the proposed action will have adverse impacts on marine mammals. Interactions between oil and whale habitat may occur several times during the lease life, and any resultant declines would be recoverable in one generation. The impact from this factor is considered low.

While the level of impacts from the sale-related activities varies, those activities having the greatest impacts most accurately represent the effect of the sale on the species because of its limited ability to sustain its population and recover from adverse impacts.

Conclusion

The impact of the proposed sale on marine mammals is estimated to be low.

(7) Impacts on Coastal and Marine Birds

Several impact-producing factors may threaten coastal and marine birds.

The OCS-related helicopter and service-vessel traffic results in displacement of birds from nesting and feeding habitats. A maximum of 1,000 service-vessel trips and 5 shuttle-tanker trips will occur per year from the Eastern Gulf to existing port areas in the Central Gulf. At worst, the effect of vessel or air traffic during any time of year is of a very short-term nature. The MMS regulates flight elevation to no lower than 2,000 ft during the time of year of greatest concentration of coastal and marine birds (mid-October to mid-April). The impact level from this factor is considered to be very low.

Pipeline landfalls and coastal facility construction results in possible desertion of birds from nesting and feeding habitats. No new OCS-related pipeline landfalls or coastal construction are projected for the proposed action. The impact level from this factor is considered to be very low.

Entanglement or ingestion of OCS-related plastic debris may injure or kill coastal and marine birds. The MMS prohibits the disposal into offshore waters of any OCS-related materials, including plastics. In addition, MARPOL, Annex V, prohibits the disposals of any plastics at sea or in coastal waters. The impact level from this factor is considered to be very low.

Oil spills pose the greatest threat to coastal and marine birds by direct oiling, food source contamination, or nesting habitat pollution. It is assumed that one large oil spill (greater than or equal to 1,000 bbl) will occur during the 39-year life of the proposed action. The highest estimated probability of oiling, contamination, or pollution involving coastal and marine birds is 1 percent. The impact level from this factor is considered to be very low.

It follows that activities resulting from the proposed action have the potential to cause very low impacts to coastal and marine birds. There will be no discernible decline in a coastal or marine bird population or species, and no change in distribution or abundance. Any individuals experiencing sublethal effects will recover to pre-impact condition in less than one generation.

Conclusion

A very low level of impact on coastal and marine birds is estimated to occur in the Eastern Gulf as a result of the Base Case.

(8) Impacts on the Commercial Fishing Industry

Several impact-producing factors may threaten the commercial fishing industry.

The emplacement of one production platform eliminates approximately 3.7 ha (9 ac) of commercial trawling space. Ten offshore platform/structures will be constructed, removing 36 ha (89 ac) from commercial trawling. This represents an inconsequential amount of the total trawling area. The impact from this factor is considered to be very low.

Oil spills pose the greatest threat to the commercial fishing industry by direct contact with eggs, larvae, juveniles, or massed spawning adult finfish or shellfish; by contamination of essential estuarine nursery habitat; or by deterrence of commercial fishing activity. It is assumed that one large oil spill (greater than or equal to 1,000 bbl) will occur during the 39-year life of the proposed action. The highest estimated probability of contact and affect, contamination, or deterrence involving commercial fishing resources is 1 percent. The impact from this factor is considered to be low.

It follows that activities resulting from the proposed action have the potential to cause low level impacts to the commercial fishing industry. There will be little discernible decline in populations of commercial importance, in the quality of essential habitats, or in commercial fishing activity. Recruitment will return any affected population, habitat, or activity to pre-impact level and/or condition within one generation.

Conclusion

A low level of impact on the commercial fishing industry is estimated to occur in the Eastern Gulf as a result of the Base Case.

(9) Impacts on Recreational Resources/Activities and Associated Tourism

(a) Beach Use

The major impact-producing factors that could adversely affect beach use in the Florida Gulf States are oil spills that contact recreational beaches; visual distractions resulting from the presence, construction, or operation of nearshore infrastructure; and, to a lesser extent, tarballs, trash, and debris that are washed up on the Gulf Coast beaches. Oil spills will result in a few, highly infrequent losses of recreational beach use or associated tourism, especially at the Statewide level. Oil-spill impact is expected to be very low. Based on the low level of OCS-related development projected for the Eastern Gulf and on the additional limitations currently imposed on leasing in the Eastern Gulf, it is expected that the impact due to the presence, construction and operation of nearshore infrastructure will be negligible. Tarballs, trash, and debris resulting from the proposed sale in the EPA are expected to be highly infrequent and to have a negligible impact on recreational beach use.

Based on the Base Case Analysis of all the impact-producing factors discussed above, the interference with the quality of recreational beaches may be perceptible, but it is unlikely to generate increased beach maintenance or to affect the quantity or quality of recreational beach use and associated tourism.

Conclusion

The proposed action is expected to result in a very low impact, if any, on recreational beach use and associated tourism along the Florida Gulf Coast, the Florida Keys, or Dry Tortugas.

(b) Recreational Fishing

Recreational fishing is unlikely to be adversely affected by the proposal except in the rare event of a large oil spill that comes ashore and impacts marinas, fishing areas, and sport fish populations. Impacts resulting from a large spill on recreational fishing are most likely to be localized and temporary, lasting from 1 to 4 weeks or the time required to control the spill at its source and to cleanup the affected marinas and other fish access sites. Production platforms are likely to improve fishing success in the immediate vicinity of the platform throughout the production life of a lease.

Conclusion

The proposed action is expected to have a very low, if any, adverse impact on recreational fishing in the Eastern Gulf of Mexico.

(10) Impacts on Archaeological Resources

(a) Historic

The greatest impact to an historic cultural resource as a result of the proposed action would result from a contact between an OCS offshore activity (platform installation, drilling rig emplacement, and pipeline projects) and an historic shipwreck. The archaeological surveys that are conducted prior to initiating oil and gas activities within a lease block are estimated to be 90 percent effective at locating historic shipwrecks in the Eastern Gulf. A recently completed, MMS-funded study (Garrison et al., 1989) has provided new data on shipwreck locations in the Gulf. The impact level from this factor is considered to be very low.

Other activities associated with the proposed action are expected to have very low impacts on historic archaeological resources. No new onshore infrastructure construction or pipeline landfalls are expected as a result of the proposed action. Historic cultural resources, therefore, will not be affected by these activities. The chances of contact from an oil spill associated with the proposed action is very low. Furthermore, the impact from an oil-spill contact on an historic coastal site, such as a fort or a lighthouse, would be visual due to oil contamination. These impacts would be temporary and reversible.

To summarize, because of the effectiveness of the archaeological survey at identifying possible shipwrecks, the absence of new onshore infrastructure construction, and the low probability of contact and low level of impact from an oil spill, if one should occur, the impact level of the proposed action is considered to be very low.

Conclusion

The level of impact to historic sites in the Eastern Gulf as a result of the proposed action is expected to be very low.

(b) Prehistoric

Several impact-producing factors may threaten the prehistoric archaeological resources of the Eastern Gulf. An impact could result from a contact between an OCS activity (pipeline and platform installations, drilling rig emplacement and operation, and anchoring activities) and a prehistoric site located on the continental shelf. The archaeological surveys that are required prior to an operator beginning oil and gas activities in a lease block are estimated to be 90 percent effective at identifying possible prehistoric sites. Since the survey provides a significant reduction in the potential for a damaging interaction between an impact-producing factor and a prehistoric site, the impact level from this event is considered to be very low.

Onshore development as a result of the proposed action could result in the direct physical contact between new facility construction and pipeline trenching. None of these activities are expected to occur under the Cumulative Scenario. The impact level from these factors is considered to be very low.

Should an oil spill contact a coastal prehistoric site, the potential for dating the site using radiocarbon methods could be destroyed. Previously unrecorded sites could also experience an impact from oil spill cleanup operations on beaches. The probability of a large spill contacting a coastal prehistoric site is very low (less than 0.5%), and it is assumed that no contact will occur. No spills greater than 1 and less than or equal to 1,000 bbl are assumed to contact the coast. The impact level from an oil spill is expected to be very low.

It follows from the above that none of the activities resulting from the proposed action will cause significant levels of impact to prehistoric archaeological resources. The impact level from these activities is expected to be very low.

Conclusion

The level of impact to prehistoric sites in the Eastern Gulf as a result of the proposed action is expected to be very low.

c. Potential Mitigating Measures

(1) Live-bottom (Low Relief) Stipulation

The low-relief live-bottom areas of the Eastern Gulf provide habitat for seagrasses (Section III.B.1.c.), corals, and coral community organisms (Section III.B.2.a.). As discussed in Sections IV.D.3.a.(1)(c) and IV.D.3.a.(2), these communities would be adversely impacted by unrestricted oil and gas activities resulting from the proposed action if such activities took place on or near these communities. The DOI has recognized this problem for some years, and since 1976 stipulations have been made a part of leases on blocks on or near enough to these biotic communities for the nearby oil and gas activities to have an impact on these communities. This stipulation does not prevent the recovery of oil and gas resources, but does serve to protect valuable and sensitive biological resources. The potential stipulation is presented as an option for the Secretary's consideration. The low-relief Live-bottom Stipulation was developed by a DOI workshop of MMS and FWS biologists. Comments were solicited from Federal and State agencies, industry, academia, and interested environmental groups.

Since live-bottom areas (Sections III.B.1.c. and III.B.2.a.) are poorly mapped and discontinuously distributed on the Florida shelf, this stipulation would require an interpretation for and the identification of live bottom areas in the Eastern Gulf where it is believed such areas may exist. Lessees would be required to conduct photodocumentation surveys within 1,000 m of a proposed activity and prepare a live bottom survey report based on the data. The report would include a bathymetry map of the area and an interpretation for live bottoms within the area covering a minimum of 1,000 m from the proposed activity site. If live bottoms are identified within 1,000 m of the proposed activity, the Regional Director may then impose appropriate protective measures to insure their protection. The stipulation reads as follows:

> Live Bottom (Low Relief) Stipulation
> (Eastern Planning Area)
>
> (To be included on leases on blocks in water depths of 100 m or less.)
>
> For the purpose of this stipulation, "live bottom areas" are defined as seagrass communities; or those areas which contain biological assemblages consisting of such sessile invertebrates as sea fans, sea whips, hydroids, anemones, ascidians, sponges, bryozoans, or corals living upon and attached to naturally occurring hard or rocky formations with rough, broken, or smooth topography; or areas whose lithotope favors the accumulation of turtles, fishes, and other fauna.
>
> Prior to any drilling activities or the construction or placement of any structure for exploration or development on this lease, including, but not limited to, well drilling and pipeline and platform placement, the lessee will submit to the Regional Director (RD) a live bottom survey report containing a bathymetry map prepared utilizing remote sensing techniques and an interpretation of live bottom areas prepared from a photodocumentation survey. The live bottom survey report, including the attendant surveys, will encompass an area within a minimum 1,000 m distance of a proposed activity site.
>
> If it is determined that live bottom areas might be adversely impacted by the proposed activity, then the RD will require the lessee to undertake any measure deemed economically, environmentally, and technically feasible to protect live bottom areas. These measures may include, but are not limited to, the following:

(a) the relocation of operations to avoid live bottom areas; (b) the shunting of all drilling fluids and cuttings in such a manner as to avoid live bottom areas; (c) the transportation of drilling fluids and cuttings to approved disposal sites; and (d) the monitoring of live bottom areas to assess the adequacy of any mitigating measures taken and the impact of lease initiated activities.

Effect of the Lease Stipulation

This potential stipulation would serve to protect both the seagrass beds from OCS-related impacts described in Section IV.D.3.a.(1)(c) and the low-relief live-bottom communities from the potenial impacts described in Section IV.D.3.a.(2)(a). This biological stipulation, if imposed, would reduce the potential impact of this proposed action on these live bottom areas of the Eastern Gulf in water depths less than 100 m. The potential impacts to seagrass beds would be reduced from low to very low and to the low-relief live bottoms from moderate to very low. This would be accomplished by requiring the positive identification of live bottom areas prior to any drilling activity, allowing the RD to take effective action on a case-by-case basis to protect the identified live bottom area. The stipulation would require a report that would identify live bottom areas utilizing a detailed bathymetry map and a photographic survey. An analysis of this report by MMS, with consultation with FWS, would determine whether live-bottom areas requiring protection from potential harmful impacts due to oil and gas operations are present. If such areas are present, various protective measures may be involved: relocation of the operations far enough away from the live bottom to prevent the harmful impacts; if the relief of the live bottom is enough (i.e., greater than 10-15 m), shunting of all drilling effluents may be the method of choice; if relocation and shunting are not feasible and the area is considered to be of high sensitivity and ecological importance that no potential degradation should be risked and yet the drilling itself can take place without risk, it may be determined that drilling effluents will have to be transported to a disposal site away from live bottom areas. Coordination with USEPA will be required in this latter instance; or if the sensitivity and ecological importance of the areas are high, but the risk to them is considered low, it may be decided to require the lessee to conduct a monitoring study of the effects of his operation on the live bottom biota. Depending on the area and new ideas, technology, or procedures, other methods or combination of methods may be utilized to protect live bottom resources.

A live bottom stipulation has been in place on leases in the Eastern Gulf since 1976 and has also been used on leases in the Central Gulf and in the South Atlantic area. The evidence from monitoring reports, environmental reports, and live bottom survey reports in the Eastern Gulf supports the effectiveness of this stipulation. Absent this stipulation, live bottom areas could go undetected and may be seriously damaged by oil and gas exploration and development activities.

This potential stipulation has been deemed necessary in the past by the Secretary since the location of these sensitive and high value live bottom areas are poorly known, low-relief (or no relief), patchy, scattered, and generally unmapped at the local level.

If this potential biological stipulation is adopted for the appropriate blocks of this proposed action, the potential impact levels to seagrass beds would be reduced from low to very low, and the low-relief live bottoms would be reduced from moderate to very low.

(2) Archaeological Resources Stipulation

The archaeological survey requirement of the stipulation is proposed for application on all leases which fall within archaeological resources zones 1 and 2. Zone 1 has a high potential for the occurrence of historic shipwrecks and for prehistoric sites. Zone 2 has a high potential only for prehistoric sites. The stipulation serves to reduce the potential for development-related impacts to archaeological sites by requiring remote sensing surveys within archaeological zones 1 and 2 prior to lease developments. These surveys, by recording evidence of potential archaeological resource locations, makes avoidance or mitigation of impacts possible. The stipulation and a discussion of its effects are located in Section II.A.1.c.(3) for the Central Gulf.

(3) Military Areas Stipulation

Military areas stipulation No. 1 proposed for the Eastern Gulf is identical to the military areas stipulation proposed for the Central and Western Gulf and would apply to all blocks leased within a warning or water test area. The stipulation has been applied to blocks in warning areas in past lease sales in the Eastern Gulf and is considered by DOI and DOD to be an effective method of mitigating potential multiple-use conflicts. See Section II.A.1.c.(4) for the stipulation and a discussion of its effect. An additional clause is added to stipulation No. 1 for blocks located within warning areas W-151, W-470, and W-168 and water test areas 1, 2, 3, 4, and 5. The clause reads as follows:

> *Evacuation*
>
> When the activities of the Armament Development and Test Center at Eglin Air Force Base, Florida, may endanger personnel or property, the lessee agrees, upon receipt of a directive from the RD, to evacuate all personnel from all structures on the lease and to shut-in and secure all wells and other equipment, including pipelines on the lease, within 48 hours or within such longer period as may be specified by the directive. Such directive shall not require evacuation of personnel and shutting-in and securing of equipment for a period of time greater than 72 hours; however, such a period of time may be extended by a subsequent directive from the RD. Equipment and structures may remain in place on the lease during such time as the directive remains in effect.

Effect of the Lease Stipulation (Evacuation Clause)

This stipulation clause would reduce the risk to crew life threatened by falling debris, low-flying planes and missiles, and other weaponry during the times of intensive testing and training at Eglin Air Force Base.

The intrinsic dangers to the oil industry offshore are falling debris, low-flying planes, and weapons testing. Threat to life and property could exist to crews and structures without proper control of OCS structures and operations in the area. This stipulation clause would reduce the risk to crew life threatened by falling debris and weaponry. However, application of the clause will cause a shut-down of all oil and gas operations in the affected areas for a period of time up to 3 days. This means a possible loss of revenue to industry and a downtime for men and rented and leased equipment.

The following stipulation is also proposed for the EPA. The stipulation restricts the location of exploratory drilling and regulates the times at which activities can take place within certain areas of the Eastern Gulf. This stipulation would cover the blocks within warning areas W-151, W-470, and W-168 and Eglin Water Test Areas 2, 3, and 4.

Military Areas Stipulation No. 2

> The placement, location, and planned periods of operation of surface structures on this lease during the exploration stage are subject to approval by the RD after the review of an operator's Plan of Exploration (POE). Prior to approval of the POE, the RD shall consult with the Commander, Armament Division, Eglin Air Force Base, Florida, and the Commanding Officer, Naval Command Systems Center, Panama City, Florida, in order to determine the POE's compatibility with scheduled military operations. The POE will serve as the instrument for promoting a predictable and orderly distribution of surface structures, determining the location and density of such structures, and maximizing exploration while minimizing conflicts with Department of Defense activities. A POE will be disapproved in accordance with 30 CFR 250.33(i)(3) if it is determined that the proposed operations will result in interference with scheduled military missions in such a manner as to possibly jeopardize the national defense or to pose unacceptable risks to life and property. Moreover, if there is a serious threat of harm or damage to life or property, or if it is in the interest of national security or defense, approved operations may be suspended in accordance with

30CFR 250.10(b)(2) and (3). The term of the lease will be extended to cover the period of such suspension or prohibition. It is recognized that the issuance of a lease conveys the right to the lessee as provided in Section 8(b)(4) of the OCS Lands Act to engage in exploration, development, and production activities conditioned upon other statutory and regulatory requirements.

Effect of the Lease Stipulation

The stipulation regarding the timing and location of surface structures and periods of operation applies to warning areas W-151, W-470, and W-168, and Eglin Water Test Areas 2, 3, and 4. At the time the lessee files an Application for Drilling Permit, the RD must consult with the Eglin AFB Commander or the Commander, Naval Command System Center (NCSC), Panama City, Florida, to determine if the drilling can take place in relation to military activities and existing oil and gas development. Eglin AFB prefers that exploration activities be restricted to a single finite area, approximately 30 mi by 30 mi, around which the footprint of their testing and research missions can be directed.

The majority of the NCSC, Panama City, Florida, testing is conducted between the months of April and October with peak operating months during the summer. During this period, oil companies will be requested by the Navy to stand down from activity for a 5- to 10-day period (to a maximum of 15 days) as determined by the NCSC testing schedule under this stipulation. Companies will be able to operate, essentially unrestricted, during the October to February timeframe. This arrangement will permit unrestricted oil exploration for approximately 80 percent of the year.

Costs associated with the stipulation could be any or all of the following: (a) less leasing in the Eastern Gulf; (b) delay in leasing and/or exploration in the Eastern Gulf; (c) possible reduction of small company participation in the offering because of inability to afford exploration delays; (d) a reduction or delay in inventorying oil and gas resources in the Eastern Gulf; and (e) a reduction or delay in revenues from the offering or a reallocation of investments to other planning areas.

(4) Oil-spill Response Stipulations

Two oil-spill response stipulations, which address oil spill response containment and cleanup response capabilities, have been developed for the Eastern Gulf. These stipulations are intended to minimize the risk of oil spills reaching Florida State waters. The two oil spill response stipulations developed for the Eastern Gulf include one that applies to 168 blocks in an offshore zone between Panama City, Florida, and the western edge of the EPA that is referred to as the Oil Spill Response Stipulation for 168 Panhandle Blocks. The other oil spill response stipulation applies to the Apalachicola blocks, generally known as the 64 Outer Cape San Blas blocks and the 46 Inner Cape San Blas blocks, and is referred to as the Oil-spill Response Stipulation for the Cape San Blas blocks.

Oil Spill Response Stipulation for 168 Panhandle Blocks

> The Oil Spill Response Stipulation for 168 Panhandle Blocks reads as follows:
>
> (This stipulation will apply to blocks located off the Florida Panhandle in the Eastern Gulf of Mexico as shown on Figure II-5.)
>
> *Mechanical Oil Spill Cleanup and Containment Equipment*
>
> The operator will be required to locate state-of-the-art mechanical oil spill cleanup and containment equipment so that response to an oil spill could be accomplished within the timeframes specified in this stipulation. Exploratory and development activities being conducted in the geographical areas delineated as Areas A and B on Figure II-5 require the following response time requirements:

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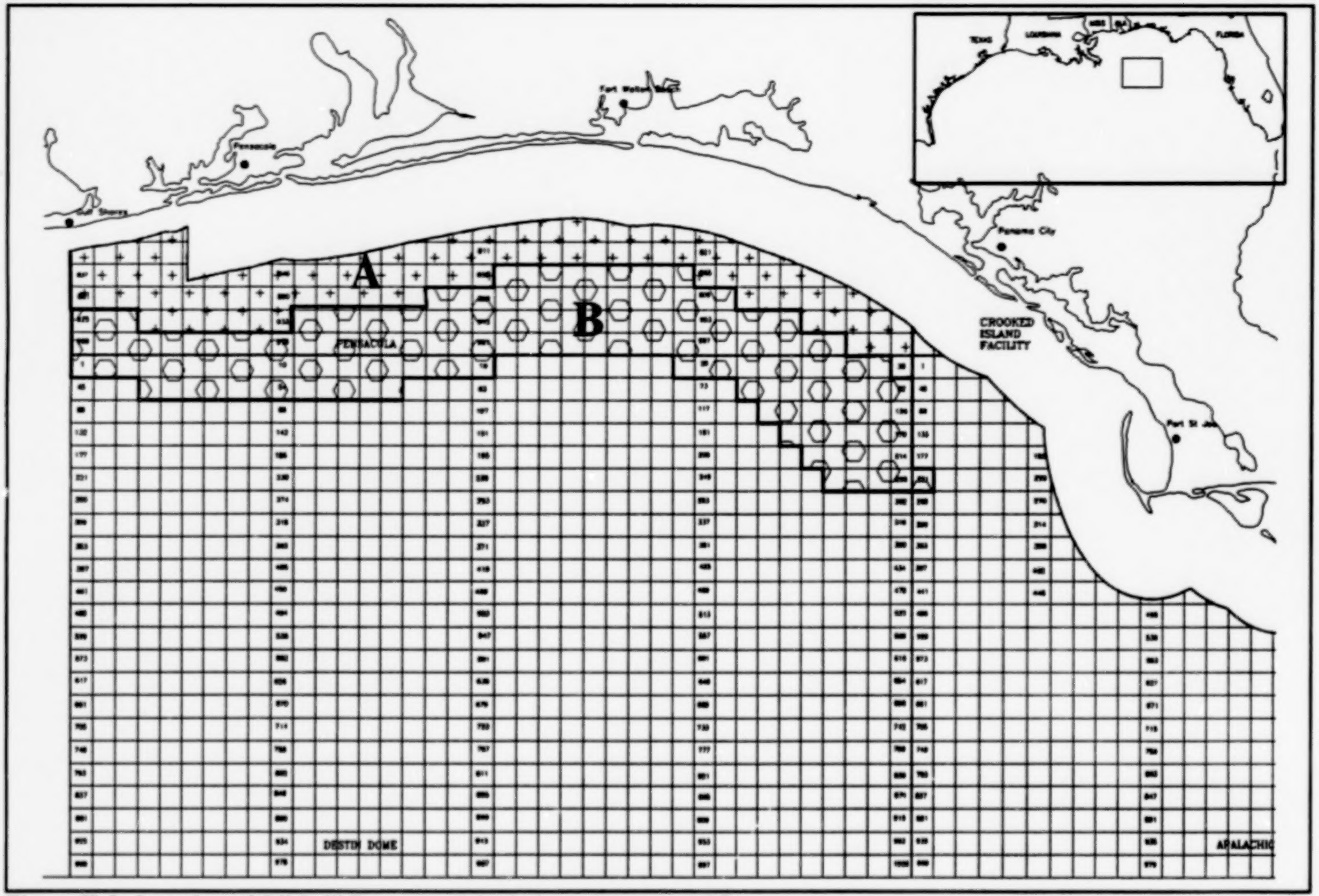

Figure II-5. Location of Oil Spill Response Stipulation Areas A and B.

Area A

Operators conducting exploratory and/or development operations within Area A will be required to be capable of immediate deployment and operation of oil spill cleanup equipment within the context of best available and safest technologies (BAST). In addition to the equipment and materials that will be required to be available to the operator at the spill response base, the following mechanical oil spill cleanup and containment equipment and materials will be required at the drill site before drilling out of the deepest proposed casing that is set above the Smackover formation: one dedicated oil spill response vessel equipped with (within the context of BAST) (1) a Fast Response System; (2) 750 ft of open ocean boom; (3) a skimmer, crane, and oil-water-separator system suitable for use with the boom; (4) a minimum of 100 bbl of storage capacity for recovered oil suitable for use with the boom; (5) a small vessel to assist in boom deployment; and (6) five bales of sorbent pads.

Area B

Those operators conducting exploratory or development activities within Area B will be required, prior to drilling out of the deepest proposed casing that is set above the Smackover formation and maintained while drilling operations are in progress, to be capable of deploying and operating the following mechanical oil spill cleanup and containment equipment and materials within 8 hours of a spill event an oil spill response vessel equipped with (within the context of BAST) (1) a Fast Response System; (2) 750 ft of open ocean boom; (3) a skimmer, crane, and oil-water-separator system suitable for use with the boom; (4) a minimum of 100 bbl of storage capacity for recovered oil suitable for use with the boom; (5) a small vessel to assist in boom deployment; and (6) five bales of sorbent pads.

To handle small spills at drill sites located in Area B, the operator will be required to maintain 200 ft of sorbent boom and a means for deployment at the rig/platform site.

Chemicals and Chemical Application Equipment

Those operators conducting exploratory or development activities within Areas A and/or B as delineated on Figure II-5 will be required to maintain at an approved oil spill equipment base state-of-the-art approved chemicals (dispersants) and chemical application equipment and have established plans approved by affected Federal agencies for their rapid use if needed. Such equipment will include but not be limited to (1) one dispersant sprayer system (capable of use on a supply vessel), (2) one Helicopter Underslung Sprayer System, (3) one 180-bbl dispersant transportation system, (4) 98 drums of dispersant appropriate for use in the area, and (5) two drums of surface oil-collecting agent.

Operational Standards

The operator or a representative(s) will be required to be capable of suitably deploying the equipment required by this stipulation and must retain personnel capable of maintaining and using such equipment. The operator will be required annually by the MMS to demonstrate equipment and personnel deployment capabilities.

In the event that the operator wishes to replace or substitute any equipment, the operator must be able to demonstrate that the capabilities of the new equipment meet or exceed that of the equipment required by this stipulation in the context of BAST. Oil spill cleanup and containment equipment located at an approved oil spill equipment base is not limited to the requirements set forth in this stipulation.

The operators will be required to fully discuss their compliance with the requirements of this stipulation in the exploration and development plans submitted for this area.

Oil Spill Response Stipulation for the Cape San Blas Blocks

The Oil Spill Response Stipulation for the Cape San Blas Blocks reads as follows:

(This stipulation will apply to the 46 whole or partial Inner Cape San Blas blocks identified as Area C on Figure II-6 and the 64 Outer Cape San Blas blocks identified as Area D on Figure II-6.)

Exploration Activity

(1) Lessees conducting exploratory operations within this area will be required to be capable of immediate deployment and operation of state-of-the-art offshore oil spill cleanup equipment within the context of standards set by the requirement to employ best available and safest technologies (BAST). In addition to the equipment and materials which will be required to be available to the operator at the spill response base, adequate cleanup and containment equipment and materials will be required at the drill site before drilling out of the deepest proposed casing that is set above the Smackover formation and maintained while drilling operations are in progress. At a minimum, such equipment will consist of an oil spill response vessel equipped with (within the context of BAST): (a) a Fast Response System; (b) 750 ft of open ocean boom; (c) a skimmer, crane, and oil-water separator system suitable for use with the boom; (d) a minimum of 100 bbl of storage capacity for recovered oil suitable for use with the boom; (e) a motor vessel sufficient to accomplish boom deployment; and (f) five bales of sorbent pads.

A determination of compliance with this provision will be made by the Regional Director.

To handle small spills at drill sites located in this area, the lessee will be required to maintain 200 ft of sorbent boom and a means for deployment and disposal at the rig/platform site. The operator must be able to provide containment and cleanup capabilities at the drill site in the surrounding waters.

(2) All lessees conducting exploratory activities within these blocks shall adhere to the requirements outlined in a containment/cleanup plan developed specifically for this area for the protection of the coastal areas adjacent to these blocks.

(3) Lessees conducting exploratory activities will be required to maintain at an approved oil spill equipment base state-of-the-art chemicals (dispersants) and chemical application equipment and have established plans approved by

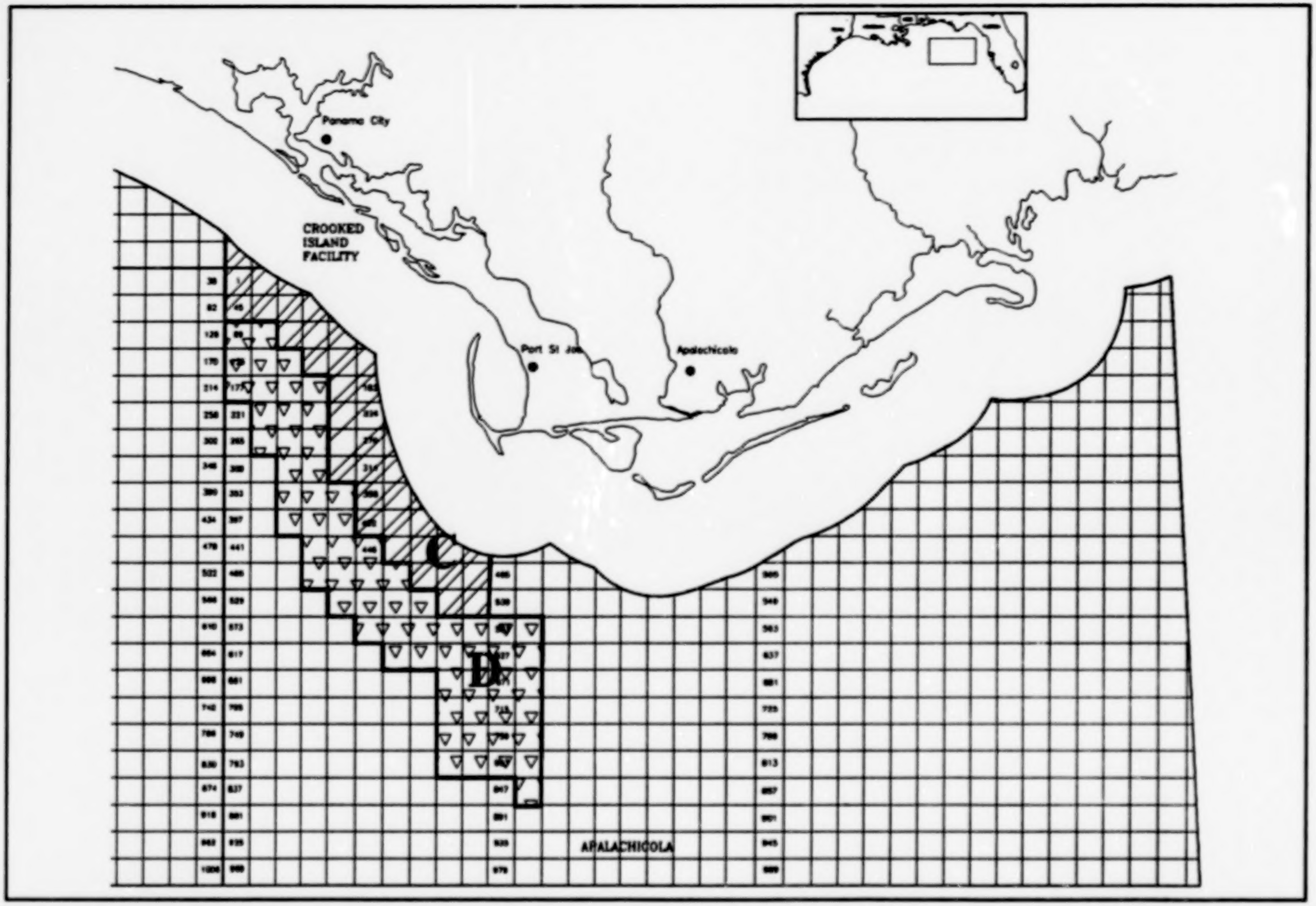

Figure II-6. Location of Oil Spill Response Stipulation Areas C and D (Area C comprises Alternative B - Delete Inner Cape San Blas Blocks).

> affected Federal agencies for their rapid application, if needed. Such equipment will include but not be limited to (a) one dispersant sprayer system (capable of use on a supply vessel), (b) one Helicopter Underslung Sprayer System (HUSS), (c) one 180-bbl dispersant transportation system, (d) 98 drums of dispersant appropriate for use in the area, and (e) two drums of a surface oil-collecting agent.

> Requirements for oil spill cleanup and containment equipment located at an approved equipment base are not limited to the requirements set forth in this stipulation. The operator will be required to fully discuss their compliance with the requirements of this stipulation in the exploration plans submitted for this area.
>
> *Production Activity*
>
> Specific oil spill cleanup and containment requirements for production activity will be developed based upon the results of exploratory drilling in this area. Information regarding the geologic formations and the characteristics of hydrocarbons discovered in this area will be considered in the development of these measures.

Effect of the Lease Stipulations

These stipulations were developed to minimize the risk of oil spills potentially reaching Florida State waters. Both oil spill response stipulations were developed in consultation with the State of Florida. The Oil Spill Response Stipulation for the Cape San Blas Blocks was developed based upon the March 24, 1988, agreement between DOI and the State of Florida. The subject stipulations require, in part, the staging of state-of-the-art mechanical oil spill response equipment to enable response within specified timeframes.

Nearshore blocks covered by the panhandle stipulation and all of the blocks covered by the Cape San Blas stipulation require equipment staged on a dedicated vessel at the drill site, ensuring an immediate response to an oil spill event. Immediate response capability would enhance the oil spill response effectiveness as it would provide cleanup capability before a large amount of oil slick spreading could occur.

In addition, both stipulations require that chemicals and chemical application equipment be maintained at an approved oil spill equipment base, ensuring that this oil spill response capability exists and is in a state of readiness. This readiness will be assessed, in part, through the MMS review of a lessee's OSCP, which includes a requirement for a dispersant use plan that contains an inventory of dispersants to be utilized; a summary of toxicity data for each dispersant; a description of the types of oil on which each dispersant is effective; a description of dispersant application equipment and procedures, including logistics; and an outline/decision tree for deciding upon dispersant use and in obtaining approval. The discussion of logistics would include the expected timeframes for dispersant application after approval for dispersant use has been granted. The required 200 ft of sorbent boom at the rig sites should provide an operator the immediate ability to handle small spills, particularly those resulting from fuel transfers.

The Oil Spill Response Stipulation for the Cape San Blas Blocks requires that all lessees conducting exploratory activity in this area adhere to the provisions outlined in the containment/cleanup plan developed specifically for the protection of the adjacent coastal areas. The containment/cleanup plan will supplement a lessee's OSCP by providing site-specific information to be utilized in developing the OSCP. As addressed previously, a lessee's OSCP must adhere to the requirements outlined in 30 CFR 250.42. This containment/cleanup plan provision ensures that the areas of special biological sensitivity would be considered in a lessee's oil spill contingency plan, thereby helping to protect these as well as other areas from oil spills as response measures specifically for these resources would be considered. Protection of these special biological areas would serve to reduce the chance for spilled oil to reach these areas, thereby reducing the effects on the biological resources of these areas.

2. Alternative B - Delete Inner Cape San Blas Blocks

Description of the Alternative

This deletion alternative would remove from consideration for leasing purposes those areas within the Eastern Gulf of Mexico known as the Inner Cape San Blas Blocks--the 47 blocks, or approximately 547,400 acres, adjacent to the State/Federal boundary from Cape San Blas west to Panama City, Florida (Figure II-6) (Area C only). These 47 blocks represent about 0.6 percent of the 8,356 blocks to be offered under Alternative A (the proposed action). Alternative B would provide a buffer zone between potential oil and gas activity and the adjacent coastal areas as requested by the Governor of the State of Florida.

Impact Analysis

The following analysis is presented to provide an indication of any change in environmental protection provided under Alternative B as compared with the estimated impacts of Alternative A. Descriptions of the environmental resources of the area are provided in Section III of this document and descriptions of the potential impact-producing factors are provided in Section IV.A. Detailed analyses of the estimated impacts of Alternative A are located in Section IV.D.3. Please reference these sections for more detailed information of the resources, impact-producing factors, and estimated impacts discussed below.

Given the size of the area available for lease under Alternative A and the relatively small amount of activity projected over the 39-year life of the proposed action, it is reasonable to assume that the removal of 0.6 percent of the area probably will not significantly change those projections. Therefore, for purposes of analysis, the level of activity (i.e., numbers of wells, platforms, vessel trips, etc. (Table IV-3)) are expected to remain relatively unchanged as a result of adopting Alternative B. The only differences are that under Alternative B, no activity will take place in the deletion area and there will be a larger buffer zone off the Cape San Blas area to separate oil and gas activities and associated impacts from coastal environments.

The assumption that the levels of activity for Alternative B are virtually identical to those projected for Alternative A indicates that the impacts expected to result will be very similar to those described under Alternative A (Section IV.D.3.). In fact, because the area is a very small (0.6 percent) portion of the EPA and only contains portions of the resources analyzed in this document, the regional impacts levels are estimated to be identical to those described under Alternative A. However, there are some localized changes in the impacts as described below.

Coastal Resources

The coastal environments adjacent to the deletion area include beaches, seagrass beds, salt and fresh marshes, and estuaries. The beaches serve as important recreational sites in addition to storm protection and erosion control areas. The seagrass beds, marshes, and estuaries support numerous commercially and recreationally important fishery and wildlife species. The primary impact-producing factors of concern for these environmental resources are oil spills, emplacement of pipelines, construction of navigation channels and canals, vessel traffic, maintenance dredging, and construction of onshore facilities.

It is assumed that one oil spill will occur in the EPA during the 39-year life of the proposed action, but the probabilities for contact with the Florida Panhandle are less than 0.5 percent in 10 days (Table IV-17). Therefore, no spills are assumed to affect the area as a result of Alternative B. This probability is the same as that projected under Alternative A, but with Alternative B there is an additional buffer zone along this portion of the Florida Panhandle. This would reduce the threat to the coastal resources of the area in the very unlikely event of an oil spill or other accident. The remaining impact-producing factors projected for Alternative B are also identical to those under Alternative A, so there is not expected to be any major change for the impacts described for Alternative A (Section IV.D.3.).

One of the concerns related to the potential impact on tourism is the aesthetic effect of having structures in view of recreational beaches. There is already a 16-km (10-mi) buffer zone (State waters) separating the area available under Alternative A from the shoreline. It is unlikely that any structures could be seen from this distance; therefore, the addition of a larger buffer area would not appreciably change the aesthetic impacts.

Conclusion

The selection of Alternative B could reduce very slightly the chance of the above factors affecting the coastal areas, but not enough to change the regional impact levels estimated under Alternative A: coastal barriers (very low); wetlands (very low); seagrasses (low); coastal and nearshore water quality (very low); air quality (very low); the federally protected piping plover (low); coastal and marine birds (very low); and recreational resources/activities and associated tourism (very low). Locally, the impacts to these resources could be even less.

Offshore Resources

Deletion of this area would preclude drilling operations and associated activities from occurring within the affected blocks. It would further eliminate the threat of damage from drilling discharges, anchoring, or platform/pipeline emplacement related to the exploration and development of this area. The following analyses deal specifically with the sensitive resources that may exist in the deletion area and for which there might be a change in impacts with the selection of this alternative (deep-water benthic communities are not located in the area, so there would be no change in the impact level projected for Alternative A).

Live Bottoms

The seafloor in this area contains scattered live-bottom communities comprised of sponges, octocorals, gorgonians, and a few small, hard corals. Hard substrate outcrops are thought to exist in the area. Elimination of mechanical damage due to anchoring and platform/pipeline emplacement and elimination of potential muds and cuttings discharges would preclude impacts on live-bottom features in the deletion area. This would remove the possibility of very localized impacts in the area from the drilling of no more than a few wells each year.

Conclusion

Selection of Alternative B would eliminate potential impacts on very localized areas contained in the deletion area, but this would not be significant enough to change the regional impact level on live-bottoms as projected under Alternative A (moderate).

Offshore Water Quality

The impact-producing factors leading to water quality degradation resulting from offshore OCS oil and gas operations include the resuspension of bottom sediments through exploration and development activities, pipeline construction, and platform removal operations; the discharge of deck drainage, sanitary and domestic wastes, formation waters (produced waters), and drilling fluids (muds and cuttings); and accidental hydrocarbon discharges due to spills, blowouts, or pipeline leaks. All of these factors, except the last, impact only very small areas near the source and for only a short time; the last factor is estimated to be very unlikely to occur. Thus, adoption of Alternative B would completely eliminate all but the last factor as a threat to the water quality of the area. However, because the area is a small portion of the entire area offered for leasing, the regional impact level will be reduced by only that small amount, assuming that oil and gas activities would be reduced proportionally.

Conclusion

Selection of Alternative B would eliminate potential impacts on very localized areas contained in the deletion area, but this would not be significant enough to change the regional impact level on offshore water quality as projected under Alternative A (low).

Endangered and Threatened Species and Marine Mammals

Subadult and adult loggerhead, green, hawksbill, and Kemp's ridley sea turtles are likely to occur in the Inner Cape San Blas deletion area because the depth of the area is within the range of their preferred habitat. Hatchlings of these species and hatchling leatherback sea turtles could also occur in the area. The bottlenose dolphin is the most common marine mammal in the deletion area because of its relatively shallow depth, although a variety of small cetaceans could infrequently occur. Sea turtles and marine mammals could be impacted by oil and gas activities through contact with or ingestion of oil, collision with vessels, entanglement in or ingestion of debris generated from platforms, or physical/acoustic disturbances (drilling, structure placement and removal). Deletion of this area from the sale would eliminate all impacts to sea turtles and marine mammals that would occur from proposed action-related oiland gas operations within the deletion area. If the area is deleted from the proposed sale, impacts to marine mammals and sea turtles in the deletion area will not change significantly from those of Alternative A because of the low level of oil and gas activity proposed and the small number of marine mammals and sea turtles in the area. To the extent that they are present in this small portion of the EPA, regional impacts to these species will be reduced by that same small amount. The impacts on the species that were analyzed under Alternative A but not mentioned above, such as the Florida manatee, will remain the same because the species are not normally found in the deletion area.

Conclusion

Selection of Alternative B would reduce potential impacts on endangered and threatened species and marine mammals in and near the deletion area, but the regional reduction would not be significant enough to change the regional impact level on these resources as projected under Alternative A: Kemp's ridley sea turtle (moderate); loggerhead sea turtle (low); great whales (low); Florida manatee (moderate); Gulf sturgeon (low); and marine mammals (low).

Historic and Prehistoric Archaeological Resources

The implementation of this deletion alternative will remove approximately 15 blocks contained within the high probability zone for the occurrence of historic shipwrecks (Zone 1) and 44 within the high probability zone for the occurrence of prehistoric archaeological sites (Zone 2). A recently completed MMS study on historic shipwreck distribution and preservation in the Gulf of Mexico (Garrison et al., 1989) has identified the Cape San Blas area as a high-concentration shipwreck zone because of the increased frequency of shipwreck occurrences in the vicinity of navigational hazards associated with the Cape San Blas shoals. This deletion alternative would therefore remove blocks that have a particularly high probability for the occurrence of historic archaeological resources and would result in a lessened chance of contact between an oil and gas project on the OCS and a shipwreck. The archaeological surveys, however, that are conducted prior to initiating oil and gas activities within a lease block are estimated to be 90 percent effective at locating historic shipwrecks in the Eastern Gulf. Based on this high percentage, it is likely that a shipwreck would be identified in the deletion area during an archaeological survey if the area were available for leasing. The implementation of this deletion alternative will, therefore, reduce further the already very low chances of a contact between an OCS activity and a shipwreck.

The deletion alternative would remove a very small percentage of all lease blocks in the Eastern Gulf that are contained within the high probability zone for prehistoric resources. The archaeological surveys for prehistoric resources are estimated to be 90 percent effective at locating prehistoric sites. Based on this effectiveness, even in the absence of the deletion, the probability of a contact between an archaeological site and an OCS activity is very low.

Conclusion

Selection of Alternative B would reduce further the potential impacts to archaeological resources in the deletion area, but the expected level of impact to historic and prehistoric resources under Alternative A is already very low and would not change.

3. Alternative C - Delete Naval Operations Area

Description of the Alternative

This alternative would delete 244 blocks, or approximately 1.4 million acres, contained within the Destin Dome map area proposed from Sale 137. These 244 blocks represent about 3 percent of the 8,356 blocks to be offered under Alternative A (the proposed action). The deletion area is shown on Figure II-7 and is contained within Warning Area W-155, which is shown on Visuals Nos. 3 and 3E and on Figure II-7. Alternative C is offered for the Secretary's consideration to minimize the conflict between OCS operations and military training maneuvers and related use of ocean space in the deletion area.

The U.S. Navy conducts pilot training from the aircraft carrier *U.S.S. Lexington* in W-155 and performs weapon systems exercises from a variety of vessels and aircraft including subsea launches, air-to-air, air-to-surface, and surface-to-surface firing. The use of W-155 by the U.S. Navy is anticipated to increase in the immediate future and to expand in the years to come. A Navy Battle Group is currently planned for the EPA under the Home Porting program. The flag ship of the Battle Group will be the aircraft carrier *Kitty Hawk*. The Battle Group will be conducting maneuvers and training exercises on a routine basis. At present, the Pensacola Naval Air Station is an operational area for the Atlantic Fleet Command. Current plans call for this area to be upgraded to Fleet status with a commensurate increase in Navy activity.

Alternative C is offered to resolve potential space-use conflicts between OCS operations and military activities. However, selection of the alternative would remove an area from potential leasing and could have the effect of lessening the environmental impacts expected to result from the proposed action. For this reason, the environmental implications of this alternative are discussed below.

Impact Analysis

The following analysis is presented to provide an indication of any change in environmental protection provided under Alternative C as compared with the estimated impacts of Alternative A. Descriptions of the environmental resources of the area are provided in Section III of this document and descriptions of the potential impact-producing factors are provided in Section IV.A. Detailed analyses of the estimated impacts of Alternative A are located in Section IV.D.3. Please reference these sections for more detailed information of the resources, impact-producing factors, and estimated impacts discussed below.

Selection Alternative C would remove about 3 percent of the area to be offered for lease under Alternative A. This is a fairly large area but it is nearly identical to an area that has been off limits for many years to avoid conflicts with the military. Given the relatively small amount of activity projected over the life of the proposed action and the lack of industry access to this area in the past, it is reasonable to assume that the removal of the area probably will not significantly change those projections. Therefore, for purposes of analysis, the level of activity (i.e., numbers of wells, platforms, vessel trips, etc. (Table IV-3)) for Alternative A are expected to remain unchanged as a result of adopting Alternative C.

The assumption that the levels of activity for Alternative B are virtually identical to those projected for Alternative A indicates that the impacts expected to result will be very similar to those described under Alternative A (Section IV.D.3.). In fact, because the area is a very small (0.6 percent) portion of the EPA, and only contains portions of the resources analyzed in this document, the regional impacts levels are estimated to be identical to those described under Alternative A. However, there are some localized changes in the impacts as described below.

Coastal Resources

The coastal environments adjacent to the deletion area include beaches, seagrass beds, salt and fresh marshes, and estuaries. The beaches serve as important recreational sites in addition to storm protection and erosion control areas. The seagrass beds, marshes, and estuaries support numerous commercially and recreationally important fishery and wildlife species. The primary impact-producing factors of concern for these environmental resources are oil spills, emplacement of pipelines, construction of navigation channels and canals, vessel traffic, maintenance dredging, and construction of onshore facilities.

It is assumed that one oil spill will occur in the EPA during the 39-year life of the proposed action, but the probabilities for contact with the Florida Panhandle are less than 0.5 percent in 10 days (Table IV-17).

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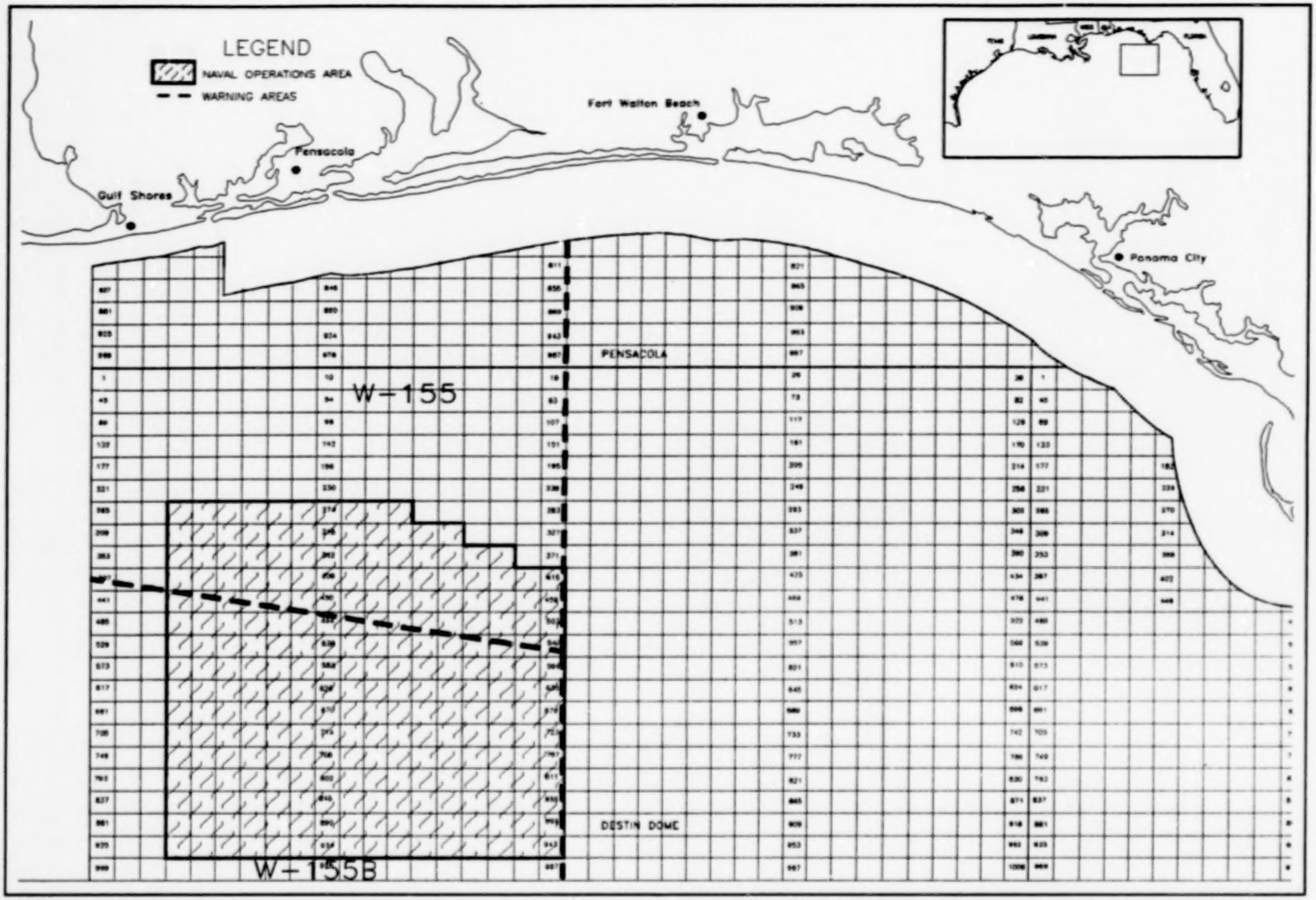

Figure II-7. Location of Alternative C - Naval Operations and Military Warning Areas W-155 and W-155B.

Therefore, no spills are assumed to affect the area as a result of Alternative C. This probability is the same as that projected under Alternative A, but with Alternative C there is an additional buffer zone along this portion of the Florida Panhandle. This would reduce the threat to the coastal resources of the area in the very unlikely event of an oil spill. The remaining impact-producing factors projected for Alternative C are also identical to those under Alternative A, so there is not expected to be any change for the impacts described for Alternative A (Section IV.D.3.).

One pipeline that would carry product from the area offshore the Florida Panhandle to Alabama is projected. It is possible that this pipeline would not be constructed if Alternative C is selected. Shuttle tanker traffic carrying production from leases outside of the deletion area could cross through portions of the area on its way to offload in Pascagoula, Mississippi. Approximately 99 shuttle tanker trips are projected under the proposed action. This number is not expected to be reduced by the selection of Alternative C because the tankers would be transporting oil produced outside of the deletion area. It is possible that the estimated number of service vessel trips to Panama City, Florida (520 over the 39-year life of the proposed action) would be reduced somewhat.

Conclusion

The selection of Alternative C could reduce very slightly the chance of the above factors affecting the coastal areas, but not enough to change the regional impact levels estimated under Alternative A: coastal barriers (very low); wetlands (very low); seagrasses (low); coastal and nearshore water quality (very low); air quality (very low); the federally protected piping plover (low); coastal and marine birds (very low); and recreational resources/activities and associated tourism (very low).

Offshore Resources

Deletion of this area would preclude drilling operations and associated activities from occurring within the affected blocks. It would further eliminate the threat of damage from drilling discharges, anchoring, or platform/pipeline emplacement related to the exploration and development of this area. The following analyses deal specifically with the sensitive resources that may exist in the deletion area and for which there might be a change in impacts with the selection of this alternative.

Live Bottoms

Portions of the seafloor in this area contain live-bottom communities comprised of sponges, octocorals, gorgonians, and a few small, hard corals. Hard substrate outcrops are known to exist in the area. Elimination of mechanical damage due to anchoring and platform/pipeline emplacement and elimination of potential muds and cuttings discharges would preclude impacts on live-bottom features in the deletion area. This would remove the possibility of a small amount of very localized impacts in the area from the drilling of no more than a few wells each year.

Conclusion

Selection of Alternative C would eliminate potential impacts on very localized areas contained in the deletion area, but this would not be significant enough to change the regional impact level on live-bottoms as projected under Alternative A (moderate).

Deep-water Benthic Communities

Much of the area covered by Alternative C is deeper than 400 m; thus, there is a potential for chemosynthetic communities to be found in the area. The only impact-producing factor threatening these communities results from those activities that would physically disturb the bottom, such as the routine operations of anchoring, drilling and pipeline installation, and the rare seafloor blowout accident. No studies or reviews of these deep-water benthic communities in this area have been conducted, but it is possible that these communities are present. Adoption of Alternative C would eliminate all impacts from oil and gas operations to any communities that might be in the area. To the extent that they are present in this small portion of the EPA, regional impacts to the chemosynthetic communities of the EPA will be reduced by that same small amount.

Conclusion

Selection of Alternative C would eliminate potential impacts on very localized areas contained in the deletion area, but this would not be significant enough to change the regional impact level on deep-water benthic communities estimated under Alternative A (low for low-density communities and moderate for high-density communities).

Offshore Water Quality

The impact-producing factors leading to water quality degradation resulting from offshore OCS oil and gas operations include the resuspension of bottom sediments through exploration and development activities, pipeline construction, and platform removal operations; the discharge of deck drainage, sanitary and domestic wastes, formation waters (produced waters), and drilling fluids (muds and cuttings); and accidental hydrocarbon discharges due to spills, blowouts, or pipeline leaks. All of these factors, except the last, impact only very small areas near the source and for only a short time; the last factor is estimated to be very unlikely to occur. Thus, adoption of Alternative C would completely eliminate all but the last factor as a threat to the water quality of the area. However, because the area is a small portion of the entire area offered for leasing, the regional impact level will be reduced by only that small amount, assuming that oil and gas activities would be reduced proportionally.

Conclusion

Selection of Alternative C would eliminate potential impacts on very localized areas contained in the deletion area, but this would not be significant enough to change the regional impact level on offshore water quality as projected under Alternative A (low).

Endangered and Threatened Species and Marine Mammals

An adult loggerhead sea turtle, Risso's dolphins, striped dolphins, sperm whales and *Kogia* have been sighted in the vicinity of the Naval Operations Area. Subadult and adult Kemp's ridley, loggerhead, hawksbill, and green sea turtles are unlikely to frequent the area because depths are in excess of their preferred habitat. However, hatchlings of these species and leatherback sea turtles could occur throughout the area. Contact with or ingestion of oil, collision with vessels, entanglement in or ingestion of debris generated from platforms, or physical/acoustic disturbances (drilling, structure placement and removal). Deletion of this area from the sale would eliminate all impacts to sea turtles and marine mammals that may have occurred from proposed action-related oiland gas operations in the area. Regional impacts to these species will be reduced by that same small amount. The impacts on the species that were analyzed under the proposed action but not mentioned above, such as the Florida manatee, will remain the same because the species are not normally found in the deletion area.

Conclusion

Selection of Alternative C would reduce potential impacts on endangered and threatened species and marine mammals in and near the deletion area, but the regional reduction would not be significant enough to change the regional impact level on these resources as projected under A: Kemp's ridley sea turtle (moderate); loggerhead sea turtle (low); great whales (low); Florida manatee (moderate); Gulf sturgeon (low); and marine mammals (low).

Historic and Prehistoric Archaeological Resources

The deletion of the Naval Operations Area will remove blocks that are located beyond the high probability zone for historic archaeological resources. The MMS does not require an historic archaeological survey to be conducted in these blocks because of the expected low probability for the occurrence of shipwrecks. The implementation of this deletion alternative would, therefore, have no effect on the impact level on historic resources which would remain very low.

All but six of the lease blocks, or approximately 305,000 acres, within the deletion area are outside of high probability Zone 2 for prehistoric archaeological resources. The MMS does not require a prehistoric archaeological survey in blocks outside of Zone 2 because these blocks would have been subaerially exposed by lowered sea levels at a time prior to the arrival of prehistoric human populations in the Gulf area.

Conclusion

Selection of Alternative C would reduce further the potential impacts to archaeological resources in the deletion area, but the expected regional level of impact to historic and prehistoric resources under Alternative A is already very low and would not change.

4. Alternative D - Delete Drone Operations Area

Description of the Alternative

This alternative will delete 60 whole or split lease blocks, or approximately 305,000 acres, west and south of Cape San Blas, extending into the Gulf of Mexico approximately 64-80 km (40-50 mi) offshore in the northwest part of the EPA. These 60 blocks represent about 0.7 percent of the 8,356 blocks to be offered under ALternative A (the proposed action). The area is located within Warning Area 151 (Visual No. 3E) and is shown on Figure II-8. This alternative is offered for the Secretary's consideration to minimize the conflict between activities of OCS operations and military training maneuvers and the related use of ocean space in and about the area south of the Tyndall Air Force Base in the EPA.

The U.S. Air Force conducts Research, Design, Testing, and Evaluation (RDTE) with the use of unmanned aircraft as aerial targets. These flying targets, or drone aircraft, are controlled from ground stations located in coastal Florida. Military activity involving drone aircraft occurs well offshore (about 80-160 km (50-100 mi)) in Warning Area 151. It is necessary for these aircraft to travel from a land base to the target area and return, if intact, after the engagement. The use of an approach corridor is required to conduct these maneuvers. This corridor is the area that would be deleted with the selection of this alternative. The corridor is an area of intense military activity during training exercises and could pose a serious threat to the safety of personnel working on fixed placed structures in this corridor.

Alternative D is offered to resolve potential space-use conflicts between OCS operations and military activities. However, selection of the alternative would remove an area from potential leasing and could have the effect of lessening the environmental impacts expected to result from the proposed action. For this reason the environmental implications of this alternative are discussed below.

Impact Analysis

The following analysis is presented to provide an indication of any change in environmental protection provided under Alternative D as compared with the estimated impacts of Alternative A. Descriptions of the environmental resources of the area are provided in Section III of this document and descriptions of the potential impact-producing factors are provided in Section IV.A. Detailed analyses of the estimated impacts of Alternative A are located in Section IV.D.3. Please reference these sections for more detailed information of the resources, impact-producing factors, and estimated impacts discussed below.

Given the size of the area available for lease under Alternative A and the relatively small amount of activity projected over the 39-year life of the proposed action, it is reasonable to assume that the removal of 0.6 percent of the area probably will not significantly change those projections. Therefore, for purposes of

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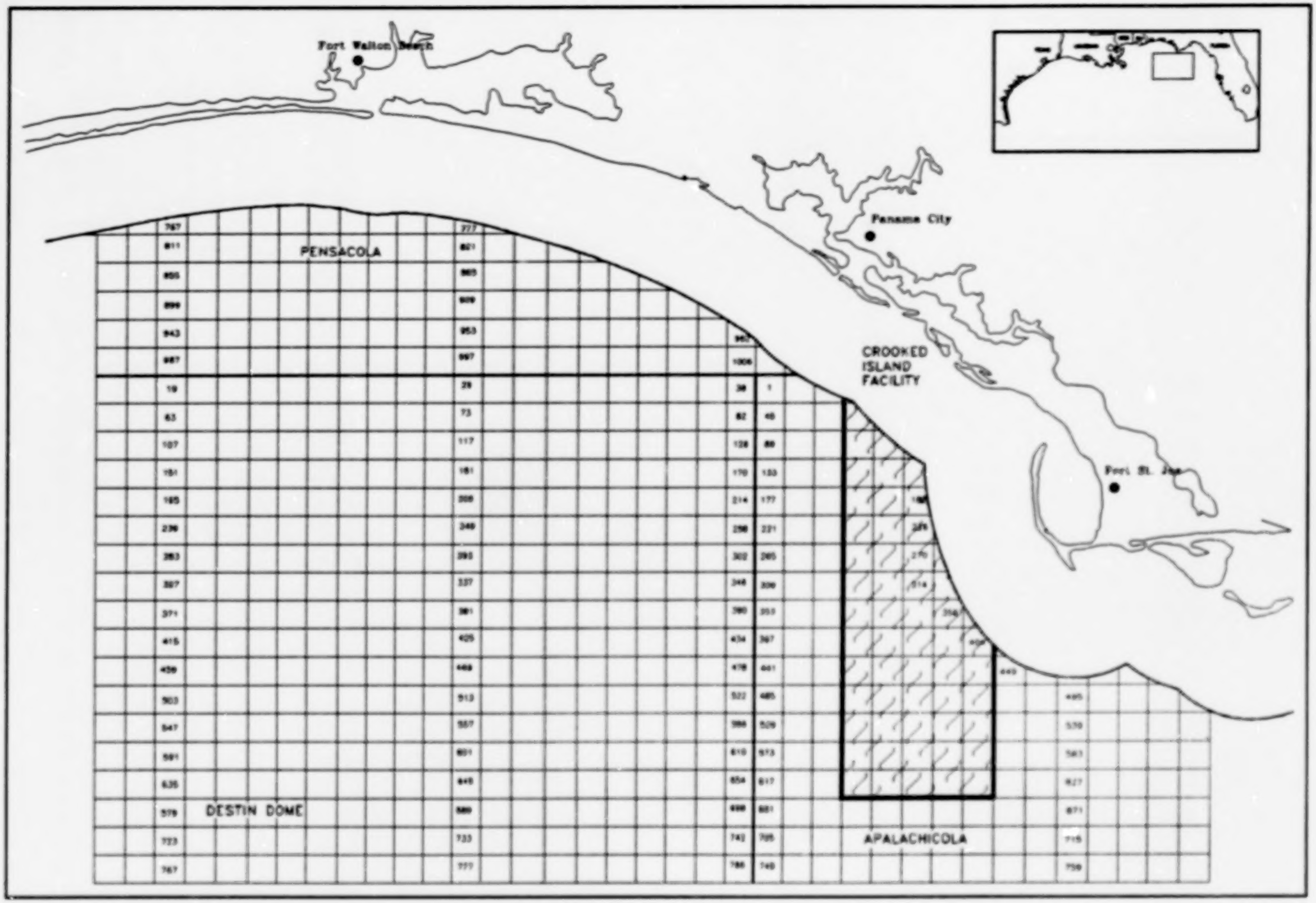

Figure II-8. Location of Alternative D - Drone Operations Area.

analysis, the level of activity (i.e., numbers of wells, platforms, vessel trips, etc. (Table IV-3)) are expected to remain unchanged as a result of adopting Alternative D. The only differences are that, under Alternative D, no activity will take place in the deletion area and there will be a larger buffer zone Off the Cape San Blas area to separate oil and gas activities and associated impacts from coastal environments.

The assumption that the levels of activity for Alternative D are virtually identical to those projected for Alternative A indicates that the impacts expected to result will be very similar to those described under Alternative A (Section IV.D.3.). In fact, because the area is a very small (0.7 percent) portion of the EPA and only contains portions of the resources analyzed in this document, the regional impacts levels are estimated to be identical to those described under Alternative A. However, there are some localized changes in the impacts as described below.

Coastal Resources

The coastal environments adjacent to the deletion area include beaches, seagrass beds, salt and fresh marshes, and estuaries. The beaches serve as important recreational sites in addition to storm protection and erosion control areas. The seagrass beds, marshes and estuaries support numerous commercially and recreationally important fishery and wildlife species. The primary impact-producing factors of concern for these environmental resources are oil spills, emplacement of pipelines, construction of navigation channels and canals, vessel traffic, maintenance dredging, and construction of onshore facilities.

It is assumed that one oil spill will occur in the EPA during the 39-year life of the proposed action, but the probabilities for contact with the Florida Panhandle are less than 0.5 percent in 10 days (Table IV-17). Therefore, no spills are assumed to affect the area as a result of Alternative D. This probability is the same as that projected under Alternative A, but with Alternative D there is an additional buffer zone along this portion of the Florida Panhandle. This would reduce the threat to the coastal resources of the area in the very unlikely event of an oil spill. The remaining impact-producing factors projected for Alternative D are also identical to those under Alternative A, so there is not expected to be any change for the impacts described for Alternative A (Section IV.D.3.).

One of the concerns related to the potential impact on tourism is the aesthetic effect of having structures in view of recreational beaches. There is already a 16-km (10-mi) buffer zone (State waters) separating the area available under Alternative A from the shoreline. It is unlikely that any structures could be seen from this distance; therefore, the additional area would not change the aesthetic impacts.

Conclusion

The selection of Alternative D could reduce very slightly the chance of the above factors affecting the coastal areas, but not enough to change the regional impact levels estimated under Alternative A: coastal barriers (very low); wetlands (very low); seagrasses (low); coastal and nearshore water quality (very low); air quality (very low); the federally protected piping plover (low); coastal and marine birds (very low); and recreational resources/activities and associated tourism (very low).

Offshore Resources

Deletion of this area would preclude drilling operations and associated activities from occurring within the affected blocks. It would further eliminate the threat of damage from drilling discharges, anchoring, or platform/pipeline emplacement related to the exploration and development of this area. The following analyses deal specifically with the sensitive resources that may exist in the deletion area and for which there might be a change in impacts with the selection of this alternative (deep-water benthic communities are not located in the area, so there would be no change in the impact level projected for Alternative A).

Live Bottoms

The seafloor in this area contains scattered live-bottom communities comprised of sponges, octocorals, gorgonians, and a few small, hard corals. Hard substrate outcrops are thought to exist in the area. Elimination of mechanical damage due to anchoring and platform/pipeline emplacement and elimination of potential muds and cuttings discharges would preclude impacts on live-bottom features in the deletion area.

This would remove the possibility of very localized impacts in the area from the drilling of no more than a few wells each year.

Conclusion

Selection of Alternative D would eliminate potential impacts on very localized areas contained in the deletion area, but this would not be significant enough to change the regional impact level on live-bottoms as projected under Alternative A (moderate).

Offshore Water Quality

The impact-producing factors leading to water quality degradation resulting from offshore OCS oil and gas operations include the resuspension of bottom sediments through exploration and development activities, pipeline construction, and platform removal operations; the discharge of deck drainage, sanitary and domestic wastes, formation waters (produced waters), and drilling fluids (muds and cuttings); and accidental hydrocarbon discharges due to spills, blowouts, or pipeline leaks. All of these factors, except the last, impact only very small areas near the source and for only a short time; the last factor is estimated to be very unlikely to occur. Thus, adoption of Alternative D would completely eliminate all but the last factor as a threat to the water quality of the area. However, because the area is a small portion of the entire area offered for leasing, the regional impact level will be reduced by only that small amount, assuming that oil and gas activities would be reduced proportionally.

Conclusion

Selection of Alternative D would eliminate potential impacts on very localized areas contained in the deletion area, but this would not be significant enough to change the regional impact level on offshore water quality as projected under Alternative A (low).

Endangered and Threatened Species and Marine Mammals

The Drone Operations Area is within the range of depths preferred by subadult and adult loggerhead, green, hawksbill, and Kemp's ridley sea turtles. Hatchlings of these species and hatchling leatherback sea turtles could also occur in the area. The bottlenose dolphin is the most common marine mammal in the deletion area, although a variety of small cetaceans could infrequently occur. Contact with or ingestion of oil, collision with vessels, entanglement in or ingestion of debris generated from platforms, or physical/acoustic disturbances (drilling, structure placement and removal). Deletion of this area from the sale would eliminate all potential impacts to sea turtles and marine mammals that could occur from proposed action-related oil and gas operations in the deletion area. To the extent that they are present in this small portion of the EPA, regional impacts to these species will be reduced by that same small amount. The impacts on the species that were analyzed under Alternative A but not mentioned above will remain the same because the species are not normally found in the deletion area.

Conclusion

Selection of Alternative D would reduce potential impacts on endangered and threatened species and marine mammals in and near the deletion area, but the regional reduction would not be significant enough to change the regional impact level on these resources as projected under Alternative A: Kemp's ridley sea turtle (moderate); loggerhead sea turtle (low); great whales (low); Florida manatee (moderate); Gulf sturgeon (low); and marine mammals (low).

Historic and Prehistoric Archaeological Resources

The implementation of this deletion alternative will remove 26 blocks contained within the high probability zone for the occurrence of historic shipwrecks (Zone 1) and 55 within the high probability zone for the occurrence of prehistoric archaeological sites (Zone 2). A recently completed MMS study on historic shipwreck distribution and preservation in the Gulf of Mexico (Garrison et al., 1989) has identified the Cape San Blas area as a high-concentration shipwreck zone because of the increased frequency of shipwreck occurrences in the vicinity of the navigational hazards associated with Cape San Blas shoals. This deletion alternative would therefore remove tracts that have a particularly high probability for the occurrence of historic archaeological resources, and would result in a lessened chance of contact between an oil and gas project on the OCS and a shipwreck. The archaeological surveys, however, that are conducted prior to initiating oil and gas activities within a lease block are estimated to be 90 percent effective at locating historic shipwrecks in the Eastern Gulf. Based on this high percentage, it is likely that a shipwreck would be identified in the deletion area during an archaeological survey if the area had been leased. The implementation of this deletion alternative will, therefore, reduce further the already very low chances of a contact between an OCS activity and a shipwreck.

The deletion alternative would remove a very small percentage of all lease blocks in the Eastern Gulf that are contained within the high probability zone for prehistoric resources. The archaeological surveys for prehistoric resources are estimated to be 90 percent effective at locating prehistoric sites. Even in the absence of the deletion, the probability of a contact between an archaeological site and an OCS activity is very low.

Conclusion

Selection of Alternative D would reduce further the potential impacts to archaeological resources in the deletion area, but the expected regional level of impact to historic and prehistoric resources under Alternative A is already very low and would not change.

5. Alternative E - Delete the Panhandle Buffer Zone

Description of the Alternative

This alternative would delete the unleased blocks in an area that contains 642 blocks, or approximately 3.5 million acres, approximately 50 km (30 mi) seaward of the Federal/State boundary off Gulf County, Florida, and extending westward to the boundary of the EPA and CPA off Baldwin County, Alabama (Figure II-9).

These 642 blocks represent about 8 percent of the 8,356 blocks to be offered under Alternative A (the proposed action). Alternative E would allow for additional time to respond to oil spills occurring outside this area with regard to containment and cleanup activities. Likewise, it would allow time for the dispersion and weathering of spilled oil prior to contact with the shore and sensitive coastal habitats. Alternative E is under consideration because of concerns expressed during public hearings for proposed Sale 137.

Effect of the Alternative

This alternative would offer for lease 7,714 blocks in the EPA. It would exclude from leasing the area described above, as well as deferred areas encompassing the nearshore 32-48 km buffer zone, the regions south of latitude 26° N and west to approximately longitude 86° W, and 23 blocks centered around the Florida Middle Ground.

The estimated amounts of oil and gas resources assumed to be produced under Alternative E are approximately 0.039 BBO and 0.02 tcf of gas. These estimates represent a reduction of 2.5 percent in oil production and 66.7 percent in gas production with respect to the proposed action in the Eastern Gulf of Mexico.

Selection of Alternative E would also reduce the estimates of major impact-producing factors and the level of exploration, development, and production activity expected from the proposed action. The discovery and development of the resources associated with Alternative E would require the drilling of 65 exploration

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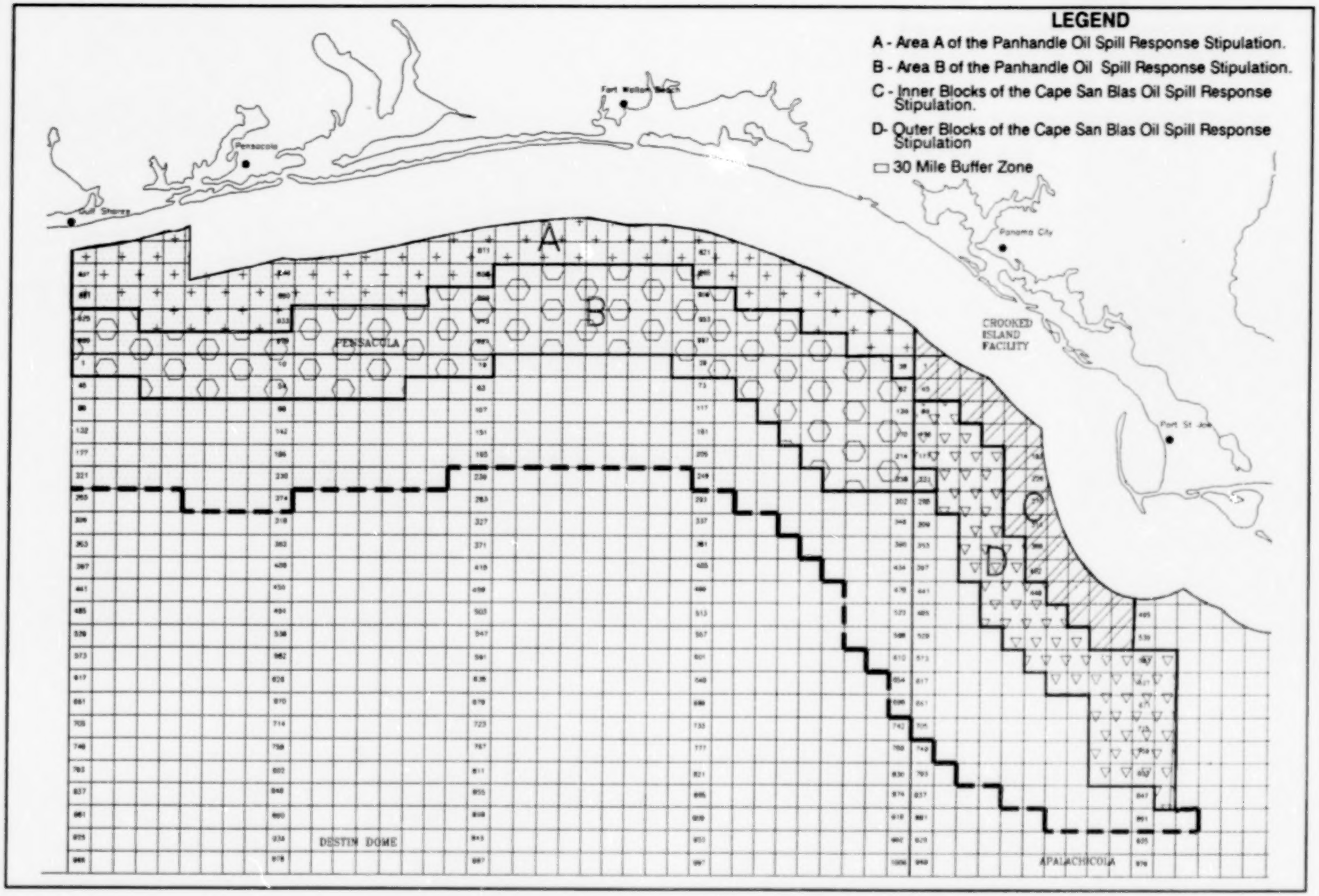

LEGEND
A - Area A of the Panhandle Oil Spill Response Stipulation.
B - Area B of the Panhandle Oil Spill Response Stipulation.
C - Inner Blocks of the Cape San Blas Oil Spill Response Stipulation.
D- Outer Blocks of the Cape San Blas Oil Spill Response Stipulation
30 Mile Buffer Zone
Fort Walton Beach
Pensacola
Gulf Shores
Panama City
Port St. Joe
CROOKED ISLAND FACILITY
A
B
C
D
PENSACOLA
DESTIN DOME
APALACHICOLA

Figure II-9. Alternative E - Delete the Panhandle Buffer Zone.

and delineation wells, the emplacement of 6 production platforms, and the drilling of 34 oil and gas development wells. Corresponding reductions in the level of the remaining major impact-producing factors are also expected and are discussed in the appropriate sections below.

The coastal and offshore resources of the EPA, which may potentially be affected by the selection of Alternative E, are those that were examined in detail under the Base Case analyses of Section IV.D.3. These impact-producing factors largely center around the mechanical disruption caused by oil and gas activities and potential oil spill effects.

Impacts on Sensitive Coastal Habitats

Coastal Barriers

Factors that affect coastal barriers include oil spills, pipeline emplacements, support infrastructure construction, and navigation canal construction and maintenance. No small spills of greater than 1 and less than 1,000 bbl are expected to occur and contact the Florida coast under this alternative (Section IV.D.3.a.(1)(a)). There is less than a 0.5 percent chance of occurrence and contact from a large oil spill. Although the Panhandle Buffer Zone is predominantly a gas prone area, the effect of the alternative will be fewer platforms and pipelines miles due to the slightly reduced amounts of oil that will be developed. Based on these considerations, no large spills are expected to occur and contact a barrier feature under Alternative E.

No new pipeline landfalls are projected in the EPA as a result of Alternative E. Therefore, there will be no pipeline emplacement impacts to coastal barriers as a direct result of the proposed sale. In addition, no new onshore support facilities or navigation canals are expected to result from Alternative E. However, maintenance dredging of existing canals that are used by supply and crew boats will occur periodically. This could interfere with littoral dynamics and alter the natural depositional patterns of sand and sediment along the coast. Wicker et al. (1989), however, have shown that the impacts of OCS navigation canals on barrier features have been minor except in the immediate areas downdrift from jetties. Furthermore, OCS-related vessel traffic will account for only a small percentage of the usage of these channels. The channels would be maintenance dredged for non-oil and -gas usage. Impacts from maintenance dredging attributable to Alternative E will therefore be very low. These factors indicate marginally less impact than the Base Case, but not enough to cause a conclusion of no impact.

Conclusion

The impact of Alternative E on coastal barriers of the Eastern Gulf is estimated to be very low.

Wetlands

The factors influencing wetlands under Alternative E include oil spills, pipeline emplacements, dredging of new navigation canals through wetlands, maintenance dredging and vessel usage of existing canals, and the construction of onshore facilities in wetland areas.

No small spills of greater than 1 and less than 1,000 bbl are assumed to occur and contact the Florida coast (Section IV.D.3.a.(1)(b)). As in the Base Case Scenario, there is less than a 0.5 percent chance of occurrence and contact from a large oil spill. From Cape San Blas southward, a nearshore deferral zone extends 32-48 km seaward from the three-league line that separates State and Federal waters. Alternative E will extend a 30-mi no-activity buffer zone north and east of Cape San Blas offshore from the Florida panhandle. Oil that reaches the coast from such a distance offshore will have spread and weathered considerably by the time a wetland area is contacted. In addition, although the area affected by Alternative E is predominantly a gas prone area, the alternative will slightly reduce the amount of oil that is developed, thereby slightly reducing the chances of occurrence and contact from an oil spill. Based on all these considerations, no large spills are expected to occur and contact coastal wetlands in the EPA under Alternative E.

No pipeline landfalls, navigation channels, or onshore infrastructure construction are expected under the Base Case Scenario. Because Alternative E will reduce the level of activity in the EPA, none of these activities are projected under Alternative E.

The major ports that will be used for access to service bases are Panama City and Port Manatee (Table IV-7). Both of these ports are located along the shores of bays, so dredge disposal and the wakes of OCS-related vessels should not have a large impact on wetlands since the dredged channel will be located at a distance from the shoreline along much of the route to the port facility. Furthermore, by virtue of removing resources from development offshore from the panhandle area of Florida, Alternative E will reduce the level of activity offshore Panama City and will reduce usage of that port. These reductions are likely to result in less impact on wetlands from the Base Case, but not enough to change the regional level.

Conclusion

The level of impact to mangroves and coastal marshes in the EPA under Alternative E is expected to be very low.

Seagrasses

Factors affecting seagrasses include oil spills, pipeline emplacement, blowouts, anchoring, platform emplacement and removal, and effluent discharges. Under Alternative E, the impacts from these potential sources to live-bottom communities center around the mechanical disruption of the benthic environment and oil spills.

Potential impacts from both mechanical disturbances and oil spills are slightly less than that estimated under the Base Case because of the reduced number of platforms installed (from 10 to 6), the reduction in the number of exploratory wells drilled (from 90 to 65), the reduction of the length of pipeline required (from 80 to 55.5 km), the lower level of discharges of muds and cuttings (from 637,000 to 450,000 bbl and from 72,000 to 51,000 yd^3, respectively), and the lower level of anchoring from fewer service vessel trips (from 5,000 to 3,000). Mechanical impacts from these factors would be precluded because of the proposed 50-km (30-mi) buffer zone, as all coastal regions of the west coast of Florida will contain a large buffer zone protecting all of the nearshore seagrass beds if this alternative is selected. Additional incremental protection to the seagrass within the potentially deleted areas from oil spills would also result from the selection of Alternative E. The Base Case impact level presented in Section IV.D.3.a.(2)(a) reflects the very small chance of an oil spill occurring and contacting the nearshore regions of Florida and the potential impacts from such an occurrence. The adoption of Alternative E would remove the already low potential for oil spills to occur in the region removed from the deleted blocks. Adoption of Alternative E would provide incremental protection to the live-bottom communities of the region, but because of the small size of the area removed, it would not change the regional impact level from that of the Base Case.

Conclusion

The impact of Alternative E on seagrasses of the Eastern Gulf is estimated to be moderate.

Impacts on Sensitive Offshore Habitats and Communities

Live Bottoms

Factors affecting live bottoms under this alternative include oil spills, pipeline emplacement, blowouts, anchoring, platform emplacement and removal, and effluent discharges. Under Alternative E, the impacts from these potential sources to live-bottom communities center around the mechanical disruption of the benthic environment and oil spills.

Potential impacts from both mechanical disturbances and oil spills are slightly less than that estimated under the Base Case because of the reduced number of platforms installed (from 10 to 6), the reduction in the number of exploratory wells drilled (from 90 to 65), the reduction of the length of pipeline required (from 80 to 55.5 km), the lower level of discharges of muds and cuttings (from 637,000 to 450,000 bbl and from 72,000 to 51,000 yd^3, respectively), and the lower level of anchoring from fewer service vessel trips (from 5,000 to 3,000). Mechanical impacts from these factors would be moved seaward of the proposed 50-km (30-mi) buffer zone, as all coastal regions of the west coast of Florida will contain a large buffer zone if this alternative is selected. Additional incremental protection to the live-bottom communities within the potentially deleted areas from oil spills would also result from the selection of Alternative E. The Base Case impact level presented in Section IV.D.3.a.(2)(a) reflects the very small chance of an oil spill occurring and contacting the nearshore regions of Florida and the potential impacts from such an occurrence. The adoption of Alternative E would remove the already low potential for oil spills to occur in the region removed from the deleted blocks. Adoption of Alternative E would provide incremental protection to the live-bottom communities of the region, but because of the small size of the area removed, it would not change the regional impact level from that of the Base Case.

Conclusion

The impact of Alternative E on live-bottom communities of the Eastern Gulf is estimated to be moderate.

Deepwater Benthic Communities

The only impact-producing factor threatening the chemosynthetic communities is physical disturbance of the bottom, which would destroy the organisms comprising these communities. Such disturbance would come from those OCS-related activities associated with pipelaying, anchoring, structure emplacement, and seafloor blowouts. Only structure emplacement is considered to be a threat, and then only to the high-density (Bush Hill-type) communities; the widely distributed low-density communities would not be at risk. The provisions of NTL 88-11 (currently in effect), requiring surveys and avoidance prior to drilling, will reduce, but not completely eliminate, the risk.

The area that would be deleted by the adoption of Alternative E is in water depths shallower than 400 m; thus, no chemosynthetic communities would be removed from possible impact, and the impact of the factors analyzed in Section IV.D.3.a.(2)(b) would apply here as well.

Conclusion

The estimated level of impact of Alternative E on the localized deep-water benthic communities of the Bush Hill type in the Eastern Gulf is expected to be moderate. The impact to the widespread low-diversity areas and those of the Florida escarpment is expected to be low.

Impacts on Water Quality

Coastal and Nearshore

The major causes of coastal and nearshore water quality degradation resulting from activities projected for the proposed action are chronic spills and low-level point and nonpoint source pollution. Such discharges and spills are primarily associated with the effluents from the three service bases expected to serve Sale 137, from bilge and ballast water discharges and release of antifouling paints associated with 3,000 service vessel trips to these service bases, from dredging due to shoreline alteration near the three service bases (occurring primarily to support other commercial and recreational activities), and from potential small oil spills at the three service bases. These discharges and spills are expected to occur at a slightly decreased level under Alternative E because the amount of activity at the three service bases would be decreased proportionally to the decrease in the amount of resource production expected to occur. For example, service vessel trips would decrease from a total of 5,000 trips to 3,000 trips during the life of Alternative E. The small number of spills from platforms and shuttle tankers and operational discharges from shuttle tankers projected under the proposed action were not expected to affect coastal and nearshore water quality (Section IV.D.3.a.(3)(a); therefore, any reduction in offshore spills under Alternative E would not change the impact from these sources.

The ability of water to assimilate through dilution and biochemical processes can be stressed when there is more than one source or type of contamination. In particular, the areas around the service bases will receive contamination from bilge waters, anti-fouling paints, chronic spills of diesel oil and oil field supplies, and from some maintenance dredging occurring partially to support the bases. Therefore, low-level localized impacts are expected to occur near Panama City, Port Manatee in Tampa Bay, and Fort Myers when all activities are examined together, i.e., there will be some disturbance of water quality characteristics related to Alternative E. Regionally, adoption of Alternative E would not alter the very low impact on the Florida coastal and nearshore water quality expected to occur under the proposed action.

Conclusion

Impacts from Alternative E on coastal and nearshore water quality is expected to be very low regionally.

Offshore

Factors affecting offshore water quality include oil spills, pipeline emplacement, blowouts, anchoring, platform emplacement and removal, and effluent discharges (including sediment resuspension resulting from those activities).

Resuspension of bottom sediments may result from drilling operations, platform and pipeline installation, and platform removal operations. Some measures of water quality parameters may change from background levels with little effect to the users of the water, and then only very close to the source.

Operational discharges (drilling muds and cuttings, produced waters, deck drainage, and sanitary and domestic wastes) may degrade some measures of water quality, changing them from background levels, but with little effect to the users of the water, and then only very close to the source. Accidental oil spills (there is an estimated 5% chance of an oil spill greater than or equal to 1,000 bbl occurring in the Eastern Gulf as a result of Alternative E) may degrade some measures of water quality, changing them from background levels, but with little effect to the users of the water, and then only in a very limited area close to the source.

Additional incremental protection to the offshore water quality within the potentially deleted area from oil spills would also result from the selection of Alternative E. The Base Case impact level presented in Section IV.D.3.a.(3)(b) reflects the very small chance of an oil spill occurring and contacting the nearshore regions of Florida and the potential impacts from such an occurrence. The adoption of Alternative E would remove the already low potential for oil spills to occur in the deleted blocks.

Potential impacts from both mechanical disturbances and oil spills are slightly less than that estimated under the Base Case because of the reduced number of platforms installed (from 10 to 6), the reduction in the number of exploratory wells drilled (from 90 to 65), the reduction of the length of pipeline required (from 80 to 55.5 km), and the lower level of anchoring from fewer service vessel trips (from 5,000 to 3,000). Potential impacts from routine discharges would also be reduced: drilling muds from 637,000 bbl to 450,000 bbl; drill cuttings from 72,000 to 51,000 yd^3; and produced waters discharged offshore from 338 to 207 MMbbl. Similarly, the amount of pipeline-disturbed sediments would be reduced from 500,000 to 300,000 yd^3.

Adoption of Alternative E would provide incremental protection to the offshore water quality of the region, but because of the small size of the area removed, it would not change the regional impact level from that of the Base Case.

Conclusion

The impact of Alternative E on offshore water quality of the Eastern Gulf is estimated to be low.

Impacts on Air Quality

Air quality degradation may occur from onshore and offshore operational emissions as a result of drilling and production activities. Short-term degradation of air quality could occur as a result of a large oil spill; however, this impact would be localized geographically and would disperse rapidly in time, making the environmental effects negligible. Operational emissions, shown in Table IV-41, would be reduced proportionally to the reduction in estimated oil and gas recovery for Alternative E. Potential impacts are slightly less than that estimated under the Base Case because of the reduced number of platforms installed (from 10 to 6), the reduction in the number of exploratory wells drilled (from 90 to 65), and the fewer number of vessel trips (from 5,000 to 3,000). Adverse impacts to coastal air quality is not expected due to the 32- to 48-km (20- to 30-mi) deferral measured from the three-league State/Federal line and to the deferral of all blocks south of latitude 26° N. The level of new offshore activity adjacent to the shore from this action is expected to be very low due to the distance to shore relationships. Increased distances to shore will result in greater dispersion of emissions.

Air quality is good in adjacent coastal counties of western Florida, as all areas are within attainment. Under this alternative, the potential effect of OCS oil and gas activity on air quality onshore at Escambia County would be reduced. The adoption of Alternative E would preclude oil and gas exploration and development activity in the deferral area. The distance to shore relationship between the coastline and potential OCS activity would exceed 35 mi. Dispersion of emissions, even under very stable conditions, is likely to result in ambient levels onshore.

Conclusion

The impact on coastal air quality is estimated to be low in Hillsborough, Pinellas, Hernando, Wakulla, and Jefferson Counties; and very low in Escambia, Monroe, and Dade Counties and throughout the remainder of the coastal areas of the Eastern Gulf.

Impacts on Endangered and Threatened Species

Kemp's Ridley Sea Turtle

Factors that may have adverse impacts on the Kemp's ridley sea turtle include anchoring, pipeline and structure emplacement, dredging, produced waters, domestic and sanitary waste, and some oil-spill impacts that would result in the disturbance of the seagrasses and benthic fauna used by sea turtles. In addition, the removal of oil and gas structures with explosives could result in shock-wave-related injuries or displacement from preferred habitats, and vessel traffic associated with the proposed action could collide with or displace sea turtles. The entrapment in or ingestion of trash and debris generated as a result of the proposed action could cause the drowning or starvation of sea turtles. In addition, contact with, ingestion of, or displacement by spilled oil resulting from the proposed action would have adverse impacts on sea turtles. Under Alternative E, the impacts from these potential sources to the Kemp's ridley sea turtle would be incrementally reduced as compared to the Base Case.

Potential impacts from factors that could disturb seagrasses and benthic fauna, from the removal of oil and gas structures with explosives, from maritime traffic, from entrapment in or ingestion of trash and debris, and from oil spills are all slightly less than that estimated under the Base Case because of the reduced total length of pipeline (from 80.0 to 55.5 km), the reduced amount of produced waters (from 338 to 207 MMbbl), the reduced number of platforms (from 10 to 6), the reduced amounts of shuttle tanker and service vessel traffic (from 99 to 96 and from 5,000 to 3,000 trips, respectively), the reduced amount of exploratory and delineation wells drilled (from 90 to 65), and the reduced amounts of oil and gas produced. Adoption of Alternative E would provide incremental protection to the Kemp's ridley sea turtles in the region, but because of the small size of the area removed, it would not change the regional impact levels from that of the Base Case.

In the Base Case, the impact levels from all factors, except for oil spills, were considered to be low. These factors would be reduced but not eliminated under Alternative E. Therefore, the impact levels would remain low under Alternative E. The impacts of spilled oil were considered to be moderate under the Base Case. Oil spill impacts would remain moderate under Alternative E.

Conclusion

The impact of Alternative E on the Kemp's ridley sea turtle is estimated to be moderate.

Loggerhead Sea Turtle

Factors that may have adverse impacts on the loggerhead sea turtle include anchoring, pipeline and structure emplacement, dredging, produced waters, domestic and sanitary waste, and some oil-spill impacts that would result in the disturbance of the seagrasses and benthic fauna used by sea turtles. In addition, the removal of oil and gas structures with explosives could result in shock-wave-related injuries or displacement from preferred habitats, and vessel traffic associated with the proposed action could collide with or displace sea turtles. The entrapment in or ingestion of trash and debris generated as a result of the proposed action could cause the drowning or starvation of sea turtles. In addition, contact with, ingestion of, or displacement by spilled oil resulting from the proposed action would have adverse impacts on sea turtles. Under Alternative E, the impacts from these potential sources to the loggerhead sea turtle would be incrementally reduced as compared to the Base Case.

Potential impacts from factors that could disturb seagrasses and benthic fauna, from removal of oil and gas structures with explosives, from vessel traffic, from entrapment in or ingestion of trash and debris, and from oil spills are all slightly less than that estimated under the Base Case because of the reduced total length of pipeline (from 80.0 to 55.5 km), the reduced amount of produced waters (from 338 to 207 MMbbl), the reduced number of platforms (from 10 to 6), the reduced amount of shuttle tanker and service vessel traffic (from 99 to 96 and from 5,000 to 3,000 trips, respectively), the reduced amount of exploratory and delineation wells drilled (from 90 to 65), and the reduced amount of oil and gas produced. Adoption of Alternative E would provide incremental protection to the Loggerhead sea turtles in the region, but because of the small size of the area removed, would not change the regional impact levels from that of the Base Case.

In the Base Case, the impact levels from all factors including oil spills were considered to be low. These factors would be reduced but not eliminated under Alternative E. Therefore, the impact levels would remain low under Alternative E.

Conclusion

The impact of Alternative E on the loggerhead sea turtle is estimated to be low.

Great Whales

Factors that may have adverse impacts on the great whales include operational discharges (drilling muds and cuttings), which may reduce the whales' food sources by death or displacement resulting from sedimentation, turbidity, or ingestion. In addition, vessel traffic associated with the proposed action could collide with or displace whales. Such interactions could cause or be indirectly related to mortality. The removal of oil and gas structures with explosives could result in shock-wave-related injuries or displacement from preferred habitats. Explosions during seismic exploration could result in shock-wave-related injuries or displacement from preferred habitats. Contact with, ingestion of, or displacement by spilled oil resulting from the proposed action will have adverse impacts on whales. Under Alternative E, the impacts from these potential sources to the great whales would be incrementally reduced as compared to the Base Case.

Potential impacts from operational discharges (muds and cuttings), vessel traffic, the removal of oil and gas structures with explosives, explosions during seismic exploration, and contact with, ingestion of, or displacement by spilled oil are all slightly less than that estimated under the Base Case because of the reduced amount of drilling muds and cuttings (from 637,000 to 450,000 bbl and from 72,000 to 51,000 yd^3, respectively), the reduced amount of shuttle tanker and service vessel traffic (from 99 to 96 and from 5,000 to 3,000 trips, respectively), the reduced number of platforms (from 10 to 6), the reduced amount of exploratory and delineation wells drilled (from 90 to 65), and the reduced amount of oil and gas produced. Adoption of Alternative E would provide incremental protection to the great whales in the region, but because of the small size of the area removed, it would not change the regional impact levels from that of the Base Case.

In the Base Case, the impact levels from all factors, except for explosions during seismic exploration and oil spills, were considered to be very low. These factors would be reduced but not eliminated under Alternative E. Therefore, the impact levels would remain very low under Alternative E. The impacts of explosions during seismic exploration and spilled oil were considered to be low under the Base Case. Explosions during seismic exploration and oil spill impacts would remain low under Alternative E.

Conclusion

The impact of Alternative E on great whales is estimated to be low.

Piping Plover

Factors that may have adverse impacts on the piping plover include pipeline landfalls, onshore construction, and onshore maintenance activities that may arise as a result of the proposed action and that may contribute to piping plover mortality by habitat destruction or displacement from preferred habitats. In addition, contact with, ingestion of, or displacement by spilled oil resulting from the proposed action will have adverse impacts on piping plovers. Under Alternative E, the impacts from these potential sources to the piping plover would be incrementally reduced as compared to the Base Case.

Potential impacts from pipeline landfalls, onshore construction, and onshore maintenance activities as well as oil spill impacts are slightly less than that estimated under the Base Case because of the reduced need to develop and maintain as many onshore support facilities and the reduced amounts of oil and gas produced. Adoption of Alternative E would provide incremental protection to the piping plover in the region, but because of the small size of the area removed, it would not change the regional impact levels from that of the Base Case.

In the Base Case, the impact levels from both factors were considered to be low. These factors may be slightly reduced but not eliminated under Alternative E. Therefore, the impact levels would remain low under Alternative E.

Conclusion

The impact of Alternative E on the piping plover is estimated to be low.

Florida Manatee

Factors that may have adverse impacts on the Florida manatee include anchoring, pipeline and structure emplacement, dredging, produced waters, domestic and sanitary waste, and some oil-spill impacts that would result in the disturbance of the seagrasses used by the Florida manatee. In addition, contact with, ingestion of, or displacement by spilled oil resulting from the proposed action would have adverse impacts on the Florida manatee. Vessel traffic associated with the proposed action could collide with or displace the Florida manatee. Such interactions could cause or be indirectly related to mortality. The entrapment in or ingestion of trash and debris generated as a result of the proposed action could cause the drowning or starvation of the Florida manatee. Under Alternative E, the impacts from these potential sources to the Florida mantee would be incrementally reduced as compared to the Base Case.

Potential impacts from factors that could disturb seagrasses, from vessel traffic, from entrapment in or ingestion of trash and debris, and from oil spills are all slightly less than that estimated under the Base Case because of the reduced total length of pipeline (from 80.0 to 55.5 km), the reduced amount of produced waters (from 338 to 207 MMbbl), the reduced number of platforms (from 10 to 6), the reduced amount of shuttle tanker and service vessel traffic (from 99 to 96 and from 5,000 to 3,000 trips, respectively), the reduced amount of exploratory and delineation wells drilled (from 90 to 65), and the reduced amount of oil and gas produced. Adoption of Alternative E would provide incremental protection to the Florida manatees in the region, but because of the small size of the area removed, it would not change the regional impact levels from that of the Base Case.

In the Base Case, the impact levels from factors that could disturb seagrasses as well as impacts from oil spills were considered to be low. These factors would be reduced but not eliminated under Alternative E and the impact levels would remain low. The impacts from entrapment in or ingestion of trash and debris in the Base Case were considered to be very low. These impacts would remain very low under Alternative E. The impacts from vessel traffic in the Base Case were considered to be moderate. Vessel traffic would be reduced but not eliminated under Alternative E; therefore, the impact level would remain moderate under Alternative E.

Conclusion

The impact of Alternative E on the Florida manatee is estimated to be moderate.

Gulf Sturgeon

Factors that may have adverse impacts on the Gulf sturgeon include operational discharges (drilling muds and cuttings) that may reduce the Gulf sturgeon's food sources by death or displacement resulting from sedimentation, turbidity, or ingestion. Under Alternative E, the impacts from operational discharges to the Gulf sturgeon would be incrementally reduced as compared to the Base Case.

Potential impacts from operational discharges (muds and cuttings) is slightly less than that estimated under the Base Case because of the reduced amount of drilling muds and cuttings (from 637,000 to 450,000 bbl and from 72,000 to 51,000 yd^3, respectively), and the reduced amount of produced waters (from 338 to 207 MMbbl). Adoption of Alternative E would provide incremental protection to the Gulf sturgeon in the region, but because of the small size of the area removed, it would not change the regional impact levels from that of the Base Case.

In the Base Case, the impact level from operational discharges was considered to be low. This factor would be reduced but not eliminated under Alternative E and the impact level would remain low.

Conclusion

The impact of Alternative on the Gulf sturgeon is estimated to be low.

Impacts on Marine Mammals

Factors that may have adverse impacts on the marine mammals include operational discharges (drilling muds and cuttings) that may reduce the marine mammals' food sources by death or displacement resulting from sedimentation, turbidity, or ingestion. In addition, vessel traffic associated with the proposed action could collide with or displace marine mammals. Such interactions could cause or be indirectly related to mortality. The removal of oil and gas structures with explosives could result in shock-wave-related injuries or displacement from preferred habitats. Explosions during seismic exploration could result in shock-wave-related injuries or displacement from preferred habitats. Contact with, ingestion of, or displacement by spilled oil resulting from the proposed action will have adverse impacts on marine mammals. Under Alternative E, the impacts from these potential sources to the marine mammals would be incrementally reduced as compared to the Base Case.

Potential impacts from operational discharges (muds and cuttings), vessel traffic, the removal of oil and gas structures with explosives, explosions during seismic exploration, and contact with, ingestion of, or displacement by spilled oil are all slightly less than that estimated under the Base Case because of the reduced amounts of drilling muds and cuttings (from 637,000 to 450,000 bbl and from 72,000 to 51,000 yd^3, respectively), the reduced amount of shuttle tanker and service vessel traffic (from 99 to 96 and from 5,000 to 3,000 trips, respectively), the reduced number of platforms (from 10 to 6), the reduced amount of exploratory and delineation wells drilled (from 90 to 65), and the reduced amount of oil and gas produced. Adoption of Alternative E would provide incremental protection to the marine mammals in the region, but because of the small size of the area removed, it would not change the regional impact levels from that of the Base Case.

In the Base Case, the impact levels from all factors, except for explosions during seismic exploration and oil spills, were considered to be very low. These factors would be reduced but not eliminated under Alternative E and the impact levels would remain very low. The impacts of explosions during seismic exploration and spilled oil were considered to be low under the Base Case and would remain low under Alternative E.

Conclusion

The impact of Alternative E on marine mammals is estimated to be low.

Impacts on Coastal and Marine Birds

Factors that may affect coastal and marine birds of the EPA under Alternative E include oil spills, disturbance of birds from feeding and nesting areas due to helicopter and OCS service-vessel traffic, displacement from onshore pipeline landfalls and facility construction near coastal nesting areas, and entanglement in or ingestion of offshore oil- and gas-related plastic debris.

The OCS-related helicopter and service-vessel traffic results in displacement of birds from nesting and feeding habitats. A maximum of 1,000 service-vessel trips and 5 shuttle-tanker trips will occur per year from the Eastern Gulf to existing port areas in the Central Gulf. At worst, the effect of vessel or air traffic during any time of year is of a very short-term nature. The MMS regulates flight elevation to no lower than 2,000 ft during the time of year of greatest concentration of coastal and marine birds (mid-October to mid-April).

Pipeline landfalls and coastal facility construction results in possible desertion of birds from nesting and feeding habitats. No new OCS-related pipeline landfalls or coastal construction are projected for Alternative E. Entanglement in or ingestion of OCS-related plastic debris may injure or kill coastal and marine birds. The MMS prohibits the disposal of any OCS-related materials, including plastics, into offshore waters. In addition, MARPOL, Annex V, prohibits the disposals of any plastics at sea or in coastal waters.

Oil spills pose the greatest threat to coastal and marine birds by direct oiling, food source contamination, or nesting habitat pollution. It is assumed that one large oil spill (greater than or equal to 1,000 bbl) will occur during the 39-year life of the proposed action. The highest estimated probability of oiling, contamination, or pollution involving coastal and marine birds is 1 percent.

It follows that activities resulting from Alternative E have the potential to cause very low impacts to coastal and marine birds. There will be no discernible decline in a coastal or marine bird population or species, and no change in distribution or abundance. Any individuals experiencing sublethal effects will recover to pre-impact condition in less than one generation.

Additional incremental protection to the coastal and marine birds within the potentially deleted area from oil spills would result from the selection of Alternative E. The Base Case impact level presented in Section IV.D.3.a.(7) reflects the very small chance of an oil spill occurring and contacting the nearshore regions of Florida and the potential impacts from such an occurrence. The adoption of Alternative E would remove the already low potential for oil spills to occur in the deleted blocks.

Potential impacts from both mechanical disturbances and oil spills are slightly less than that estimated under the Base Case because of the reduced number of platforms installed (from 10 to 6), the reduced number of exploratory wells drilled (from 90 to 65), and the reduction of the length of pipeline required (from 80 to 55.5 km).

Adoption of Alternative E would provide incremental protection to the coastal and marine birds of the region, but because of the small size of the area removed, it would not change the regional impact level from that of the Base Case.

Conclusion

The impact of Alternative E on coastal and marine birds of the Eastern Gulf is estimated to be very low.

Impacts on the Commercial Fishing Industry

The major impact-producing factors on fishing activities from Alternative E include construction and removal of platforms, underwater obstructions, sale-related oil spills, and OCS-related discharges. A discussion of these activities and their effects on commercial fisheries may be found in Section IV.D.3.a.(8).

Alternative E would preclude operations and activities associated with the emplacement of 4 platforms, and the drilling of 41 exploration, delineation, and development wells. It would not preclude those impacts associated with those activities outside this area, nor impacts from pipelines or shuttle tankers transiting through the area deleted.

As a result of Alternative E, six offshore platform/structures will be constructed, removing 22.2 ha (54 ac) from commercial trawling. This represents an inconsequential amount of the total trawling area. The impact from this factor is considered to be very low.

Oil spills from Alternative E pose the greatest threat to the commercial fishing industry by direct contact with eggs, larvae, juveniles, or massed spawning adult finfish or shellfish; by contamination of essential estuarine nursery habitat; or by deterrence of commercial fishing activity. It is assumed that one large oil spill (greater than or equal to 1,000 bbl) will occur during the 39-year life of the proposed action. The highest estimated probability of occurrence and contact, and possible effect, contamination, or deterrence involving commercial fishing resources is 1 percent. The impact from this factor is considered to be low.

It follows that activities resulting from Alternative E have the potential to cause low-level impacts to the commercial fishing industry. There will be little discernible decline in populations of commercial importance, in the quality of essential habitats, or in commercial fishing activity. Recruitment will return any affected population, habitat, or activity to pre-impact level and/or condition within one generation.

Conclusion

The impact of Alternative E on the commercial fishing industry in the Eastern Gulf is estimated to be low.

Impacts on Recreational Resources/Activities and Associated Tourism

Beach Use

The major impact-producing factors that could adversely affect beach use in the Florida Gulf Coast under Alternative E are oil spills that contact recreational beaches; visual distractions resulting from the presence, construction, or operation of nearshore infrastructure; and, to a lesser extent, tarballs, trash, and debris that are washed up on the Gulf Coast beaches. Oil spills will result in a few, highly infrequent losses of recreational beach use or associated tourism, especially at the Statewide level. The adoption of Alternative E would allow additional time for dispersion and weathering, as well as for containment and cleanup of any oil spill that may occur. Based on the low level of OCS-related development projected for the Eastern Gulf and on the additional limitations imposed on leasing nearshore under Alternative E, it is expected that the impact due to the presence, construction, and operation of nearshore infrastructure will be negligible. Potential impacts from these are slightly less than that estimated under the Base Case because of the reduced number of platforms installed (from 10 to 6) and the lower level of service vessel trips (from 5,000 to 3,000). All potential impacts would be located seaward of the proposed 50-km (30-mi) buffer zone. Tarballs, trash, and debris resulting from the selection of Alternative E in the EPA are expected to be highly infrequent and to have a negligible impact on recreational beach use.

Based on the impact-producing factors discussed above, the interference with the quality of recreational beaches may be perceptible, but it is unlikely to generate increased beach maintenance or to affect the quantity or quality of recreational beach use and associated tourism. Adoption of Alternative E would provide more protection to the Florida Gulf Coast beaches than the proposed action. However, because of the small size of the area deleted and the slight reduction expected in oil production with respect to the proposed action (2.5%), it would not change the impact level from that of the Base Case.

Conclusion

Adoption of Alternative E is expected to result in a very low impact, if any, on recreational beach use and associated tourism along the Florida Gulf Coast, the Florida Keys, or Dry Tortugas.

Recreational Fishing

The major impact-producing factors on recreational fishing include construction and removal of platforms, sale-related oil spills, and OCS-related discharges, as discussed in Section IV.D.3.a.(9).(b).

Alternative E would preclude the construction and emplacement of four platforms and associated activities in the Eastern Gulf; however, it would not preclude impacts associated with OCS activities outside the area deleted.

Recreational fishing is unlikely to be adversely affected by the adoption of Alternative E, except in the rare event of a large oil spill that comes ashore and impacts marinas, fishing areas, and sport fish populations.

Impacts resulting from a large spill on recreational fishing are most likely to be localized and temporary, lasting from 1 to 4 weeks or the time required to control the spill at its source and to cleanup the affected marinas and other fish access sites. Production platforms are likely to improve fishing success in the immediate vicinity of the platform throughout the production life of a lease; however, due to their proximity to shore (greater than 40 mi), it is unlikely that many recreational fishermen would venture out into these waters.

Conclusion

Alternative E is expected to result in a very low adverse impact on recreational fishing in the Eastern Gulf of Mexico.

Impacts on Archaeological Resources

Historic

The greatest impact to an historic cultural resource as a result of Alternative E would result from a contact between an OCS offshore activity (platform installation, drilling rig emplacement, and pipeline projects) and an historic shipwreck. These factors are discussed in detail in Section IV.D.3.a.(10)(a). The potential impact-producing factors under Alternative E would be reduced from those projected under the proposed action. Preliminary projections indicate that the number of exploration and delineation wells would be reduced (from 90 to 65); platform installations would diminish (from 10 to 6); the number of development wells would be reduced (from 50 to 34); and the total pipeline length would be reduced (from 80 to 55.5 km).

The archaeological surveys that are conducted prior to initiating oil and gas activities within a lease block are estimated to be 90 percent effective at locating historic shipwrecks in the Eastern Gulf. A recently completed MMS-funded study (Garrison et al., 1989) has provided new data on shipwreck locations in the Gulf, and will increase the effectiveness of locating a shipwreck. Under Alternative E, 127 lease blocks, which have been considered to have a high probability for the occurrence of historic period shipwrecks, would be deleted.

Other activities associated with Alternative E are expected to have very low impacts on historic archaeological resources. No new onshore infrastructure construction or pipeline landfalls are expected as a result of the proposed action, nor are they expected under Alternative E. Historic cultural resources, therefore, will not be affected by these activities. The chances of contact from an oil spill associated with the proposed action is very low. Under Alternative E, the chances are considered to be very low, although somewhat reduced from the proposed action due to the greater distance from shore of any oil and gas activity. Furthermore, the impact from an oil-spill contact on an historic coastal site, such as a fort or lighthouse, would be visual due to oil contamination. These impacts would be temporary and reversible.

To summarize, because of the reduction in the number of impact-producing factors, the decline in the number of lease blocks with a high probability for historic shipwrecks, the effectiveness of the archaeological survey at identifying possible shipwrecks, the absence of new onshore infrastructure construction, and the low probability of contact and low level of impact from an oil spill, if one should occur, the impact level of Alternative E is considered to be very low. Adoption of Alternative E would provide incremental protection to the historic archaeological resources of the region, but because of the small size of the area removed, it would not change the regional impact level from that of the Base Case. Given the deletion of the high probability blocks, the reduction in impact-producing factors, the efficacy of the required archaeological surveys, and the new data on shipwreck locations in the Gulf the impact level under Alternative E is considered to be very low.

Conclusion

The level of impact to historic sites in the Eastern Gulf as a result of Alternative E is expected to be very low.

Prehistoric

Several impact-producing factors may threaten prehistoric archaeological resources of the Eastern Gulf. An impact could result from a contact between an OCS activity (pipeline and platform installation, drilling rig emplacement and operation, and anchoring activities) and a prehistoric site located on the continental shelf. These impact-producing factors as well as possible mitigating factors are discussed for the proposed action in detail in Section IV.D.3.a.(10)(b). The potential impact-producing factors under Alternative E would be reduced from those projected under the proposed action. Preliminary projections indicate that the number of exploration and delineation wells would be reduced (from 90 to 65); platform installations would diminish (from 10 to 6); the number of development wells would be reduced (from 50 to 34); and the total pipeline length would be reduced (from 80 to 55.5 km).

The archaeological surveys that are conducted prior to initiating oil and gas activities within a lease block are estimated to be 90 percent effective at identifying possible prehistoric sites. In addition, under Alternative E, 411 lease blocks identified to have a high potential for the occurrence of prehistoric archaeological sites would be deleted.

Onshore development as a result of the proposed action could result in the direct physical contact between new facility construction and pipeline trenching. None of these activities are expected to occur under Alternative E.

Should an oil spill contact a coastal prehistoric site, the potential for dating the site using radiocarbon methods could be destroyed. Previously unrecorded sites could also experience an impact from oil-spill cleanup operations on beaches. The probability of a large spill contacting a coastal prehistoric site is very low (less than 0.5%), and it is assumed that no contact will occur. Under Alternative E, no spills greater than 1 and less than or equal to 1,000 bbl are assumed to contact the coast.

It follows from the above discussion that none of the activities resulting from Alternative E will cause significant levels of impact to prehistoric archaeological resources. Adoption of Alternative E would provide incremental protection to the prehistoric archaeological resources of the region, but because of the small size of the area removed, it would not change the regional impact level from that of the Base Case. Given the reduction in the impact-producing factors under Alternative E, the deletion of 411 lease blocks considered to have a high potential for the occurrence of prehistoric sites, and the efficacy of the survey in providing a significant reduction in the potential for a damaging interaction between an impact-producing factor and a prehistoric site, the impact level from Alternative E is considered to be very low.

Conclusion

The level of impact to prehistoric sites in the Eastern Gulf as a result of Alternative E is expected to be very low.

6. Alternative F - Delay The Sale

Description of the Alternative

The adoption of this alternative delays proposed Lease Sale 137 for a period of time not to exceed one year. Adoption of this alternative would preclude drilling operations and associated impacts from occurring within the affected area for one year. It would not prevent the threat of impact or damage from existing OCS operations. Delays could occur as a result of new information that might suggest that the proposed action could cause irreparable damage, have potential conflicts with newly discovered or protected biological resources, or result in a threat to public health and welfare.

Effects of the Alternative

It is expected that the adoption of this alternative would not change the level of impact for the various resources analyzed under Alternative A, but would dely the impacts for the specified time. Other than the delay, the selection of this alternative would result in no noticeable change in the impacts expected to result from the proposed action (Base Case and High Case) and cumulative activities (Table S-5). The impacts from a 1-year delay of the proposed lease sale are expected to be qualitatively the same as those described in the proposal (Alternative A). Impact levels for the following resources would not be changed from the Base Case analyses: sensitive coastal habitats, sensitive offshore habitats, water quality, air quality, endangered and threatened species, marine mammals, coastal and marine birds, commercial fishing industry, recreational resources and tourism, and archaeological resources.

7. Alternative G - No Action

Description of the Alternative

The alternative is equivalent to cancellation of a sale scheduled for a specific timeframe on the approved 5-year OCS Oil and Gas Leasing Schedule. Sales in the Eastern Gulf are scheduled on an annual basis. By canceling the proposed sale, the opportunity is postponed or foregone for development of the estimated 0.04 BBO of oil and 0.06 tcf of gas that could have resulted from Proposed Sale 137 in the Eastern Gulf.

Effects of the Alternative

If Alternative C is selected, all impacts, positive and negative, associated with the proposed action would be canceled. This alternative would therefore result in no effect on the sensitive resources and activities discussed in Section IV.D.3.a. The incremental contribution of the proposed action to cumulative effects would also be foregone, but such effects from other activities, including other OCS sales, would remain. One contribution to cumulative effects that could increase is oil-spill risk due to the importation of foreign oil to replace the resources lost through cancellation of the proposed action.

Alternative energy strategies that could provide replacement resources for lost domestic OCS oil and gas production include energy conservation; conventional oil and gas supplies; coal; nuclear power; oil shale; tar sands; hydroelectric power; solar and geothermal energy; and imports of oil, natural gas, and LNG. These are discussed in some detail in Appendix F. The energy equivalents that may be required from several alternative energy sources, should this lease sale be permanently cancelled, are shown on Table F-10 and are based on the resources estimated by MMS to be produced as a result of the proposed action. For the purpose of clarity, this table has separately identified each potential alternative source of energy regarding substitution requirements. It is unlikely, however, that there would be a single choice between these alternatives sources, but instead, some combined effort to explore and develop further many or all of these forms as a substitute for OCS oil and gas production.

8. Comparison of Alternatives

Table S-4 provides a comparison of the impact levels of Alternative A (the Proposed Action), Alternative B (Delete Inner Cape San Blas Blocks), Alternative C (Delete Naval Operations Area), Alternative D (Delete Drone Runway Area), Alternative E (Delete the Panhandle Buffer Zone), Alternative F (Delay the Sale), Alternative G (No Action), and cumulative activities for proposed Sale 137.

Alternative A (the Proposed Action, Base Case) has the potential to result in low to very low impacts on the majority of the resources analyzed. The exceptions are live bottoms, Kemp's ridley sea turtles, and the Florida manatee, which may sustain moderate impacts. The potential impact to live-bottom areas will be lowered to very low if the potential Live-bottom Stipulation is adopted.

Alternative B (Delete Inner Cape San Blas Blocks): The adoption of this alternative may preclude any potential localized impacts to sensitive offshore habitats and species that might exist in the area, since no proposed sale-related OCS activities would take place there. However, the removal of these particular areas is not considered to be significant enough to cause changes in the estimated regional levels of impact as analyzed under Alternative A.

Alternative C (Delete Naval Operations Area): The adoption of this alternative may preclude any potential localized impacts to sensitive offshore habitats and species that might exist in the area, since no proposed sale-related OCS activities would take place there. However, the removal of these particular areas is not considered to be significant enough to cause changes in the estimated regional levels of impact as analyzed under Alternative A.

Alternative D (Delete Drone Runway Area): The adoption of this alternative may preclude any potential localized impacts to sensitive offshore habitats and species that might exist in the area, since no proposed sale-related OCS activities would take place there. However, the removal of these particular areas is not considered to be significant enough to cause changes in the estimated regional levels of impact as analyzed under Alternative A.

Alternative E (Delete the Panhandle Buffer Zone): The adoption of this alternative has the potential to result in low to very low impacts on the majority of the resources analyzed (Section IV.D.). The exceptions are live bottoms, seagrasses, Kemp's ridley sea turtles, and the Florida manatee, which may sustain moderate impacts. However, the removal of the deletion area is not considered to be significant enough to cause major changes in the estimated regional levels of impact as analyzed under the Base Case. Some local reduction in impact is likely for wetlands, seagrasses, live bottoms, nearshore water quality, coastal and marine birds, and recreational beach use.

Alternative F (Delay the Sale) would postpone any potential adverse impacts until a later time. The level of impacts would not be expected to change from those estimated under Alternative A unless substantial new information becomes available.

Alternative G (No Action) equates to cancellation of the sale and would preclude any potential impacts from the proposed action or other alternatives.

Impact levels related to cumulative effects would not be expected to change with the adoption of any of the alternatives to the proposed action. However, the incremental contributions of the proposed sale to the cumulative impacts would be avoided with the selection of Alternative G.

SECTION III

DESCRIPTION OF THE AFFECTED ENVIRONMENT

III

III. DESCRIPTION OF THE AFFECTED ENVIRONMENT

A. PHYSICAL ELEMENTS OF THE ENVIRONMENT

1. Geology

General Description

Central and Western Gulf of Mexico

Geology of the Central, Western, and Eastern Gulf of Mexico is shown on Visuals Nos. 6 and 6E, and the general sediment distribution is shown on Visual No. 5. Shedding of sediments from the Laramide Orogeny and the North American Craton resulted in deposition of a thick, terrigenous, clastic sequence in the Gulf Coast basin. If rate of deposition exceeds rate of subsidence, deltas prograde out over the continental shelf; and the sediments are redistributed over the shelf through wave action and currents. If sedimentation is less than subsidence, then a transgression results and the deltas are modified by marine processes (Shinn, 1971).

Since late Cretaceous and early Tertiary, depocenters shifted progressively southward and eastward along the Gulf Coast (Winker, 1982). The locus of deposition shifted laterally in response to changes in source of sediment supply. Lower Tertiary deposits are thickest in the Rio Grande embayment. By late Miocene, depocenters had shifted farther south and east, forming the "Terrebonne Trough" in southern Louisiana.

Regional dip of sediments of the Gulf of Mexico is interrupted by salt diapirs, growth faults, and shale diapirs. Regional systems of growth faults penetrate into the Cenozoic units beneath coastal Texas and Louisiana and the adjacent shelf. Growth faults, forming contemporaneously with sedimentation, resulted in throws increasing with depth and strata on the downthrown side thicker than on the upthrown side. The faults ensued from simultaneous failure of the delta slope from deltas that have prograded to the edge of the continental margin (Martin et al., 1984).

The prospective horizons of the northwestern continental shelf are of Miocene, Pliocene, or Pleistocene age. The environment of deposition of the continental shelf and slope in the northern Gulf of Mexico is one of the most significant factors controlling hydrocarbon production. Sediments deposited on the outer shelf and upper slope have the greatest potential for bearing hydrocarbons. This environment is the optimum zone for encountering the three ingredients necessary for the successful formation and accumulation of oil and gas: reservoir rock, source beds, and traps. Sediments deposited on the outer shelf and upper slope have the greatest potential for bearing hydrocarbons due to the following three reasons: (a) this is the location where nearshore sands interfinger with the deeper water marine shales, providing an optimum ratio of sandstone to shale--the shale may be the source rock that provides the oil and gas while the sandstone provides the reservoir into which the hydrocarbons migrate and are trapped; (b) in this environment, the organic material deposited with the fine-grained clays and muds is preserved and not oxidized as it might be in more shallow, more turbulent water; and (c) it is at this location that the increased overburden of the prograding shallow marine deposits over the plastic salt and marine shales initiates the salt flow that triggers the growth of salt domes and regional expansion faults, which, in turn, provide traps for the hydrocarbons.

The most prolific offshore production to date in the Gulf has come from the Miocene of the eastern Louisiana OCS. This area, as currently defined, has more oil than the remainder of the Texas-Louisiana area. The next most productive trend is the Pliocene trend of the central Louisiana OCS, which produces about 50 percent oil and 50 percent gas. Farther to the west, this producing trend dies out. The Miocene of western Louisiana is the third most productive trend, producing mostly gas, and the Pleistocene of offshore western Louisiana ranks fourth.

Recently, a number of oil and gas discoveries have been made along the outer shelf and upper slope offshore of Louisiana and Texas in sediments of Pleistocene age known as the Flexure Trend. On the upper slope, basinal areas between salt structures contain a thickness of as much as 3,500 m of sediment, most of which appears to be muddy slump deposits with infrequent turbidite sand zones. Some of the new discoveries indicate that turbidite sands of reservoir quality are present on the upper slope, especially in deposits of Pleistocene age. These turbidite sands would have been derived from inner-shelf areas and deposited during glacial epochs when sea level was lower and the shoreline was close to the present shelf edge.

An MMS-funded study (Berryhill, 1987) has investigated the spatial and vertical dimensions of Late Quaternary facies that occur on the continental shelf and upper slope of the northern Gulf of Mexico. This effort was the first comprehensive study of a continental shelf that relied on high-resolution seismic data as the primary data source. Study results were based on analyses of 145,000 km of subbottom profiler and 72,000 km of minisparker data. The study presents late Quaternary seismic-reflection models that can be used as exploration tools and demonstrates the interactions and processes that are involved among sediment deposition, diapirism, and sea-level fluctuations in the building of the continental shelf.

Eastern Gulf of Mexico

The geology of the Eastern Gulf of Mexico is shown on Visual No. 6E, and general sediment distribution is shown on Visual No. 5E. The continental margin of the Eastern Gulf is dominated by the Florida platform, which is composed of a thick accumulation of bathyal to neritic carbonate rocks and evaporate deposits of Mesozoic and Cenozoic ages. The platform is fronted by a prominent escarpment built by shelf-edge reef complexes during the early Cretaceous. The northern half of the platform was built on a continental foundation composed of upper Precambrian and lower Paleozoic igneous and metamorphic rocks and capped by undeformed clastic sediments of Ordovician, Silurian, and Devonian ages. Triassic red beds and associated diabases are common in the extensive graben systems that underlie northwestern Florida. Southern peninsular Florida is underlain by basement composed of volcanic and hypabyssal rocks of Triassic and early Jurassic ages. Geophysical data suggest similar basement complexes beneath the west Florida shelf and slope (Martin, 1978).

The West Florida Platform is characterized by nearly horizontal carbonate strata, with a thin covering of Pleistocene and Holocene sediments. The area has several regional scale structural features, including the Apalachicola Embayment, the Ocala Uplift, and the South Florida Basin. Within these large regional structures there are several well-known smaller features (such as the Florida Middle Ground, the Tampa Arch, and the Southwest Florida Reef Trend); and there are many of the lesser known arches, anticlines, and basins. At the edge of the West Florida Platform, there are numerous shelf-edge filled embayments and several basin structures behind the shelf-edge reef complexes.

The oldest sedimentary rocks penetrated by exploratory wells drilled in the northeastern Gulf are believed to be Upper Jurassic in age. They lie for the most part on what is believed to be a Paleozoic basement complex. The subsurface rocks of the eastern region, together with their associated hydrocarbon production, are separated into the following trends: Upper Jurassic, Lower Cretaceous, Upper Cretaceous, and Tertiary. The greatest potential for resource production appears to be from the Upper Jurassic and Lower Cretaceous; the Upper Cretaceous has limited potential; and the Tertiary-age sediments are not thought to be prospective.

Geologic Hazards

Within the Gulf of Mexico, major geohazards to oil and gas development are associated with those seafloor geologic features that result in seafloor instability. Primarily, these hazards are produced by (a) increased gradient at the edge of the continental shelf where it merges with the continental slope; (b) regional high rates of deposition on the continental shelf that cause isostatic adjustments and deep-seated gravity faulting; (c) local high rates of deposition of unconsolidated sediments on the increased gradient of the continental shelf edge that has led to intensive slumping and mudslides; (d) diapiric movement of low-density material through overlying sediment that has caused extensive deformation, the damming of sediments, gravity faulting, and slumping; (e) high, biogenic gas content in rapidly deposited sediments; and (f) karst features on the West Florida Platform.

Most structures and equipment used for minerals exploration and development can be designed to withstand the stresses of the continental shelf environment if adequate information is available. Studies developed under the former BLM (now MMS) Environmental Studies Program have been especially directed toward areas where more detailed geologic information was needed for informed management of the OCS minerals leasing program. Visuals Nos. 4 and 4E show the areas where MMS/BLM geologic studies have provided detailed information and mapping.

These studies have provided assessments of operational constraints to oil and gas exploration and production. The data and mapped information are being used on a daily basis for tract evaluation, stipulation development and application, pipeline-permit processing, protection of sensitive areas such as the Flower Garden Banks, preliminary platform emplacement, and pipeline routing.

The BLM/MMS Open File Report 80-02, in the section entitled *Oil and Gas Development in the Mississippi River Delta Mudslide* Area (USDI, BLM, 1982), cites several examples of the application of geologic studies and geohazard surveys to recent platform siting and pipeline routing in this particularly unstable seafloor environment. Studies by Berryhill and Trippett (1981) and Berryhill et al. (1982) have revealed shallow structure and sediment distribution along the shelf of the Western Gulf of Mexico and along the Texas-Louisiana border to the shelf edge.

Non-Oil and Non-Gas Mineral Resources

In the Eastern Gulf of Mexico, potential economic deposits of phosphate sands and quartz sands are thought to occur on the West Florida shelf. These minerals might be of potential value, although no prospecting or mining has occurred to date.

Several minerals in the Central Gulf of Mexico are now, or have the potential to become, commercially exploitable. The State of Louisiana is assessing and mapping sand deposits for use in shoreline restoration. Most of these deposits occur in State waters; however, some potential deposits have been found in Federal waters. Deposits of quartz sand in Federal and State waters off the coasts of Mississippi and Alabama are of interest because of their potential use in the production of glass. Sulphur and salt deposits associated with the larger number of diapiric and domed structures in the OCS seafloor have mining potential. The Caminada sulphur mine in Federal waters has recently been activated, and DOI conducted an offshore sulphur lease sale on February 24, 1988.

In addition to those discussed above, known mineral resources in adjacent coastal areas include phosphate, quartz, sand, sulphur, salt, oyster-shell, limestone, sand and gravel, and magnesia. As part of the national initiative to develop the marine mineral resources of the OCS, MMS is working with the Gulf Coast States to complete preliminary economic reconnaissance studies of nonenergy marine minerals. These efforts began during the summer of 1987. During the Ninth Annual Gulf of Mexico Information Transfer Meetings, sponsored by MMS in October 1988, participating states presented progress reports on these efforts in a session entitled *Marine Mineral Resources in the Northern Gulf of Mexico* (USDI, MMS, 1989a).

2. Meteorological Conditions

General Description

The Gulf of Mexico and adjacent coastal areas are part of the Atlantic tropical cyclone basin. Because of its extensive coastal region and almost complete enclosure by land, the Gulf is also a favorable region for the development of atmospheric disturbances associated with land and sea-surface-temperature contrasts.

Pressure, Temperature, and Relative Humidity

The western extension of the Azores-Bermuda high-pressure cell dominates circulation throughout the year, weakening in winter and strengthening in summer. The average monthly pressure reaches a minimum of 760-762 mm of mercury from west to east over the northern Gulf during the summer but attains a maximum of 766 mm of mercury during the winter. The minimum average monthly pressure occurs during the summer when the equatorial trough shifts northward. The maximum pressure occurs during the winter as a result of the presence and influence of continental cold air.

Average temperatures at coastal locations vary with latitude and exposure. In winter, they depend on the frequency and intensity of penetration by polar air masses from the north. These incursions, when they bring strong northerly winds, are called "northers" and may occur some 15-30 times between November and March.

Air temperatures over the open Gulf exhibit narrower limits of variations on both a daily and seasonal basis. The average temperature over the center of the Gulf is about 29°C in the summer; winter temperatures average between 17° and 23°C.

The relative humidity over the Gulf is high throughout the year. Minimum humidities occur during the late fall and winter when cold, continental air masses bring dry air into the northern Gulf. Maximum humidities occur during the spring and summer when prevailing southerly winds bring in warm, moist air. The recording stations from Brownsville, Texas, to Key West, Florida, show the relative humidity varies annually from a high of 87 percent at 6:00 a.m. to a low of 44 percent at noon. This variation in a 6-hour period is caused by daily warming.

Surface Winds

Winds are more variable near the coast than over open waters because coastal winds are more directly influenced by the moving cyclonic storms that are characteristic of the continent and because of the sea- and land-breeze regime. The Azores-Bermuda atmospheric high-pressure cell dominates circulation over the Gulf, particularly during the spring and summer months. In late summer, there is a general northward shift of the circulation, and the Gulf becomes more directly influenced by the equatorial low-pressure cell. During the relatively constant summer conditions, the southerly positions of the Azores-Bermuda cell generates predominantly southeasterly winds, which become more southerly in the northern Gulf. Winter winds usually blow from easterly directions with fewer southerlies but more northerlies. Winds from the west and southwest are rare at anytime during the year.

Precipitation and Visibility

Average annual precipitation along the Gulf Coast ranges between approximately 69 cm in Brownsville, Texas; 102 cm at Galveston, Texas; and 137 cm at New Orleans, Louisiana, and Fort Myers, Florida. With the exception of the South Texas region, rainfall is fairly evenly distributed throughout the year, with the greatest amounts occurring during June, July, and August when the winds are predominantly out of the south and southeast.

Precipitation is frequent and abundant throughout the year but does show distinct seasonal variation. In New Orleans, October is the only month when precipitation averages less than 8 cm; July is the wettest month and receives just under 18 cm. Stations along the entire coast record the highest precipitation values during the warmer months of the year. The warmer months usually have convective cloud systems that produce showers and thunderstorms; however, these thunderstorms rarely cause any damage or have attendant hail (USDC, 1967; Brower et al., 1972). The month of maximum rainfall for most locations is July; however, Brownsville's record maximum is in September. Winter rains are associated with the frequent passage of frontal systems through the area. Rainfalls are generally slow, steady, and relatively continuous, often lasting several days. Snowfalls are rare, and when frozen precipitation does occur, it usually melts on contact with the ground. Incidence of frozen precipitation decreases with distance offshore and rapidly reaches zero.

Warm, moist Gulf air blowing slowly over chilled land or water surfaces brings about the formation of fog. Fog occurrence decreases seaward, but visibility has been less than 800 m due to offshore fog. Coastal fogs generally last 3 or 4 hours, although particularly dense sea fogs may persist for several days. The poorest visibility conditions occur during winter and early spring. The period from November through April has the highest frequencies of low visibilities. On the South Texas coast, fog reduces visibility to less than 1,000 m on an average of 28 days/year; very dense fog in Galveston reduces visibility to 600 m about 16 days/year; and Port Arthur has an average of 42 days/year with visibility less than 600 m. Visibility around the Mississippi Delta may be lowered by industrial pollution from New Orleans or by burning marshlands. The number of days that visibility decreases to less than 400 m (heavy fog) in the Eastern Gulf decreases from 35 days/year in Pensacola to 1 day/year at Key West.

Severe Storms

The most intense and destructive storms affecting the Gulf of Mexico and adjacent coastal zones are tropical cyclones, which have their origin over the warm waters of the central Atlantic Ocean, Caribbean Sea, or the Gulf of Mexico. Tropical cyclones occur most frequently between June and November. There is a relatively high probability that cyclonic storms will cause damage to physical, economic, biological, and social systems in the Gulf. These storms are categorized by the U.S. National Weather Service according to intensity. The most intense storms are called hurricanes. They have winds of greater than 121 kilometers per hour (km/h). The determination of storm intensity at sea and in the coastal region is readily measured by current weather-forecasting methods and surveillance techniques. Recorded historical data on past storms prior to 1950 is often difficult to obtain. The probability of storm occurrence in certain coastal areas and meteorological disturbance intensity is discussed in BLM Open File Report 80-02 (USDI, BLM, 1982) and is depicted on Visual No. 7.

Extratropical cyclones originate in middle and high latitudes, forming on the fronts that separate different air masses. These storms, which may vary greatly in intensity, occur primarily during the winter months and have attained wind speeds as great as 55-93 km/h. The Gulf of Mexico is an area of cyclone development during the cooler months due to the contrast in temperatures of the warm air over Gulf waters and the cold continental air over the United States.

Hurricanes have always posed a seasonal threat to the people of the Gulf of Mexico coastal region. Damages resulting from these violent storms have been noted as far back as the Spanish explorations by Columbus in the late 1400's. Five unidentified Spanish ships carrying unknown cargo were destroyed during a 1766 hurricane in the Bay of St. Bernard (Galveston Bay). In 1778, 14 unidentified large British ships carrying lumber to Jamaica were destroyed in Pensacola Harbor by a hurricane (CEI, 1977). Indianola, Texas, was struck by a hurricane in 1875, which resulted in the destruction of three-quarters of the town; 176 lives were lost. Eleven years later Indianola was destroyed by another hurricane; the town was never rebuilt. In 1900, Galveston, Texas, was the location of the worst hurricane disaster in the history of the Gulf of Mexico. Tidal surges were recorded at 4.6-6.1 m, more than 3,600 homes were destroyed, and 6,000-8,000 people lost their lives.

Hurricanes vary considerably in intensity, track patterns, and behavior when crossing land. McGowen et al. (1970) explain that storm approach is marked by rising tides and increased wind velocities; generally, the longer a storm lingers in the Gulf, the larger the surge of water it pushes ashore as it approaches land. These storm tides are commonly higher in the bays than on Gulf sea beaches, although flooding and pounding waves affect both areas. There is no preferred approaching route of hurricane tracks (DeWald, 1982), although early season storms generally approach from the southeast and later ones are more out of the south. Most hurricanes form in tropical ocean areas; however, some are generated in the Gulf of Mexico. From 1900 to 1985, 64 tropical storms formed in the Gulf of Mexico, 32 of which became hurricanes (USDC, NOAA, 1978, updated 1985).

Hurricane damage results from high winds and, particularly in the coastal areas, the storm surge or tide, which is an abnormally high rise in the water level. Maximum surge height at any location is dependent on many factors including bottom topography, coastline configuration, and storm intensity. Damages from severe storms include environmental losses due to shore and bay erosion, wildlife- and fisheries-habitat disruptions, and direct animal population loss; economic losses to oil and gas operations, the seafood industry, and vessel casualties; and social losses resulting from human displacement, property damage, and loss of life.

In recent years, hurricanes have had a great impact on offshore oil development in addition to posing threats to residents of coastal regions. Hurricane Camille (1969) caused 262 deaths and record tidal surges of 7 m in Mississippi. Three offshore platforms were affected; the first was completely destroyed, the second was severely damaged and removed from the offshore, and the third suffered damages but was repaired and reused in another area. The damage to these three platforms, plus 1,828 m of pipelines, exceeded $40 million.

Other hurricanes that have caused destruction to offshore development are as follows: Hurricane Hilda (1964) destroyed six platforms; Hurricane Carmen (1974) caused four pipeline breaks; Hurricane Eloise (1975) caused one pipeline break; and Hurricane Bob (1979) caused one pipeline break (DeWald, 1982).

More than 500,000 people from Louisiana were evacuated in advance of Hurricane Elena (September 1985). Although Elena caused millions of dollars worth of property damage, no deaths or serious injuries resulted. Winds were recorded up to 201 km/h, and at least 10 tornados were sighted. Over 110,000 homes and businesses were left without power.

Hurricane Elena caused severe coastal erosion and landloss along the Chandeleur Islands off Louisiana. Approximately 20 percent of the total island area was removed by the storm. On many parts of the island, vegetation was stripped and major dune fields were severely damaged. The northern end of the island near the lighthouse was partially destroyed, and many tidal channels were cut through the northern quarter of the island (Louisiana Geological Survey, 1985a). Elena further affected the beaches and shores of the Florida west coast from Escambia County through Sarasota County, a shoreline distance of about 795 km. Balsillie (1985) performed a Type I erosion-value analysis relative to Hurricane Elena's effects on Florida's beaches and shores. This was an average for sampled profiles where only erosion occurred. Through this analysis, it was determined that beach and coast erosion volumes from Pinellas, Franklin, Gulf, and Escambia Counties ranged from 21 to 40 m^3 per shorefront meter of coast. The average erosion was 25 m^3 per meter.

Ninety percent of the Alabama oyster resources were lost as a result of Hurricane Elena. All major reefs--Cedar Point, Buoy, and Kings Bayou--were impacted by extreme tidal activity, hurricane force winds, and heavy rainfall from Hurricane Elena; and oyster populations were subjected to acute mechanical and physiological stress that may have drastically altered oyster population dynamics on impacted reefs. The most productive reef, Cedar Point Reef (Mobile County), was virtually destroyed. Estimates were that restoration of 479 ha of reef area by planting adequate cultch material should result in replacement of the lost oyster resources within a period of 1.5-2.0 years, provided adequate spat set occurs (Tatum, 1985). Shellfish resources in Apalachicola Bay (Franklin County) sustained severe damage. This bay system is vital to the oyster industry of Florida--over 90 percent of Florida's oyster landings come from this bay. In 1984, approximately 900 oyster-harvesting licenses were issued in Franklin County. Damage assessment following the storm indicates oyster populations on the bay's most productive reefs (Cat Point Bar and East Hole Bar) have been reduced to levels that would not support commercial harvesting. Commercially harvestable concentrations of oysters on Cat Point Bar were reduced to approximately 20 percent of the estimated harvestable oysters present before the storm. Those resources on East Hole Bar were virtually eliminated (Berrigan, personal comm., 1986).

Hurricane Juan (October/November 1985) intensified so quickly that the offshore oil and gas industry was unable to evacuate personnel on many rigs and platforms. As a result, a massive rescue of more than 140 people was performed by the U.S. Coast Guard. When the legs collapsed on the Penrod 61 drilling rig offshore Louisiana, 43 people evacuated into escape capsules; however, one capsule swamped, which resulted in the death of one crewman. By October 31, Hurricane Juan had come within 97 km of New Orleans. As a result of this storm, seven lives were lost, 50,000 homes were flooded, and there was an estimated $1 billion loss. On November 1, tropical storm Juan left Louisiana and slowly drifted toward Alabama. It was the most destructive huricane of all as far as coastal erosion and landloss are concerned. Beaches along the entire Louisiana coast eroded 6-30 m as a result of long-lasting, high tidal surges and storm waves. Channels were widened and several new inlets were created along the barrier islands, which were devegetated in some areas (Louisiana Geological Survey, 1986). Hurricane Juan also adversely affected the Louisiana shrimp industry. It hit the Louisiana coast at historically the most productive time of the year for shrimping, but boats stayed at port because of rough seas. Considerable debris and detritus were deposited on the shrimping grounds, resulting in losses to fishing gear and fishing time. The storm dispersed the population of shrimp, caused premature immigration, resulted in some shrimp mortalities, and resulted in a decrease in shrimp landings (Chatry, 1986).

3. Air Quality

Coastal Areas' Status

Air quality of the coastal areas bordering the Gulf of Mexico is measured against the National Ambient Air Quality Standards (NAAQS) resulting from the Clean Air Act, as amended, or more restrictive standards adopted by individual States. These standards are designed to preserve the air quality of an area at a threshold necessary to protect public health and welfare.

The ambient air quality in any area is determined by using special monitoring schemes (40 CFR 50) and is measured relative to NAAQS's primary and secondary standards. Primary standards are designed to protect public health, and secondary standards are designed to protect public welfare. The maximum quantities per unit of time are defined by applicable emission standards. These standards are summarized in Table III-1. The NAAQS have been adopted by all of the five Gulf Coast States. Florida has amended these standards to make emissions of total suspended particulates (PM_{10}) and sulphur oxides (SO_2) more restrictive.

The status of ambient air is based on classifications recognized by the USEPA. These classifications are as follows.

Classification	Definition
Attainment	Meets or is less than standard
Nonattainment	Exceeds standards
Unclassified	Cannot be classified or meets standards

If a county/parish or section of a county/parish does not meet the primary and/or secondary standards, it is classified as nonattainment. Unclassified areas are areas that may be in attainment but do not have sufficient current monitoring data to determine their status. For this discussion, unclassified areas are assumed to meet required standards, that is, be within attainment. The status of air quality in the Central and Western Gulf is represented in Figure III-1. The status of air quality in the Eastern Gulf is shown in Figure III-2.

Areas designated as Prevention of Significant Deterioration (PSD) areas are identified as mandatory Class I Federal areas where visibility is an important value. These areas are national and international parks and wilderness areas.

Of the 24 Florida coastal counties fronting the Eastern Gulf (including Dade County), 21 meet national standards. Three counties exceed standards for ozone (O_3). Of these three counties, one also exceeds primary and secondary standards for SO_2, and another exceeds the secondary standards for PM_{10}. Escambia, Hillsborough, and the southwest corner of Pasco County cannot be classified for SO_2. The coastal area of Florida meets national standards or cannot be classified for O_3, carbon monoxide (CO), and nitrogen dioxide (NO_2).

Both of the Alabama counties fronting the Central Gulf are clean-air counties. Statewide, PM_{10} and SO_2 meet national standards; O_3, CO, and NO_2 meet national standards or cannot be classified.

The three coastal counties in Mississippi are all clean-air counties. Statewide, PM_{10} and SO_2 meet national standards; O_3, CO, and NO_2 meet standards or cannot be classified.

Of the 14 coastal parishes in Louisiana, 7 meet NAAQS or cannot be classified for O_3, NO_2, and CO; however, 7 parishes exceed primary standards for O_3. All coastal parishes meet national standards for PM_{10} and SO_2.

Of the 16 Texas coastal counties fronting the Western Gulf, 10 meet national standards or, in some instances, cannot be classified; 3 counties exceed primary standards for PM_{10}; and 6 counties exceed primary standards for O_3.

The PSD Class I areas are located in two of the five Gulf Coast States: Florida and Louisiana. There are three PSD areas in Florida and one in Louisiana. All five states have State Implementation Plans for air quality coupled with regulatory enforcement and monitoring programs in operation. The status of nonattainment and PSD Class I areas are shown in Table III-2.

Ambient air quality is considered to be a function of the size, distribution, and activity of a population and, more importantly, the industrialization of an area. Emissions from all sources, such as external combustion, solid-waste incineration, internal combustion, evaporation, chemical processing, etc., make up the ambient air quality at any given time according to the particular rates of emission, proximity of emission sources, local meteorological conditions, and the rate of dispersion. These factors preclude the ambient air quality from remaining the same at all times and, in fact, work in unison such that peak and low conditions are observed as a function of time; that is, at certain periods the controlling factors may cause the ambient air quality to meet or exceed NAAQS and at other times it may be far below. Climatological conditions play a very important role in the dispersion of emissions, and thus, on the ambient air quality.

Table III-1

National Ambient Air Quality Standards for the Five Gulf of Mexico States, with More Restrictive Standards Shown for the State of Florida[a]

Pollutant	Timeframe	Primary Standards	Secondary Standards[b]	Florida Standards
PM 10 particulate	annual (arithmetic mean[c])	50 ug/m^{3c}	50 ug/m^3	50 ug/m^3
	24-hour	150 ug/m^2	150 ug/m^2	150 ug/m^3
Sulphur oxides	annual (arithmetic mean[c])	80 ug/m^3 (0.03 ppm)[d]	150 ug/m^3 (0.02 ppm)	60 ug/m^3 (0.02 ppm)
	24-hour	365 ug/m^3 (0.14 ppm)	260 ug/m^3 (0.1 ppm)	260 ug/m^3 (0.1 ppm)
	3-hour[b]		1,300 ug/m^3	1,300 ug/m^3 (0.5 ppm)
Carbon monoxide	8-hour[b]	10 mg/m^3 (9 ppm)	(same as primary)	(same as primary)
	1-hour[b]	40 mg/m^3 (35 ppm)	(same as primary)	(same as primary)
Nitrogen dioxide[e]	annual (arithmetic mean)	100 ug/m^3 (0.05 ppm)	(same as primary)	(same as primary)
Photochemical oxidants[f]	maximum daily[b] value	235 ug/m^3 (0.12 ppm)	(same as primary)	0.12 ppm^3

[a] The air quality standards and a description of the Federal Reference Methods (FRM) were published on April 30, 1971, in 42 CFR 410, recodified to 40 CFR 50 on November 25, 1972. The new FRM for nitrogen dioxide was published on December 1, 1976, as 40 CFR 50. Standards for PM 10 are in 40 CFR 50, July 31, 1987, and FRM appears in Appendix J.

[b] Not to be exceeded more than once a year.

[c] Arithmetic mean is the most common measure of the central tendency. It is the sum of the data collected during the given period divided by the number of observations in the same period.

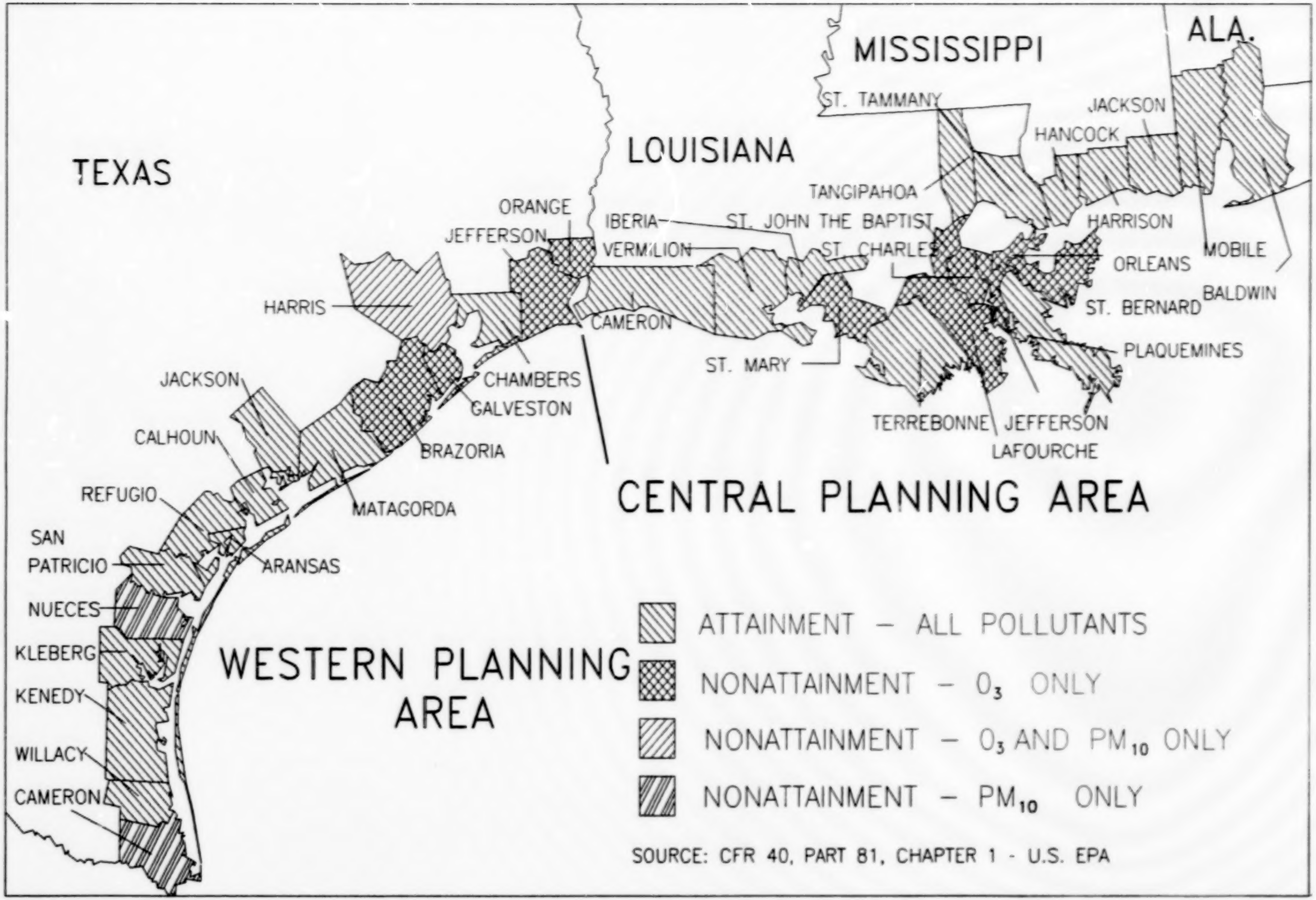
[d] Parts per million.

[e] Chemiluminescence has been established as the FRM and the sodium arsenite and trienthanolamine guiacol sulfite (TGS) methods have been identified as equivalent methods.

[f] The FRM measures 0_3 (ozone).

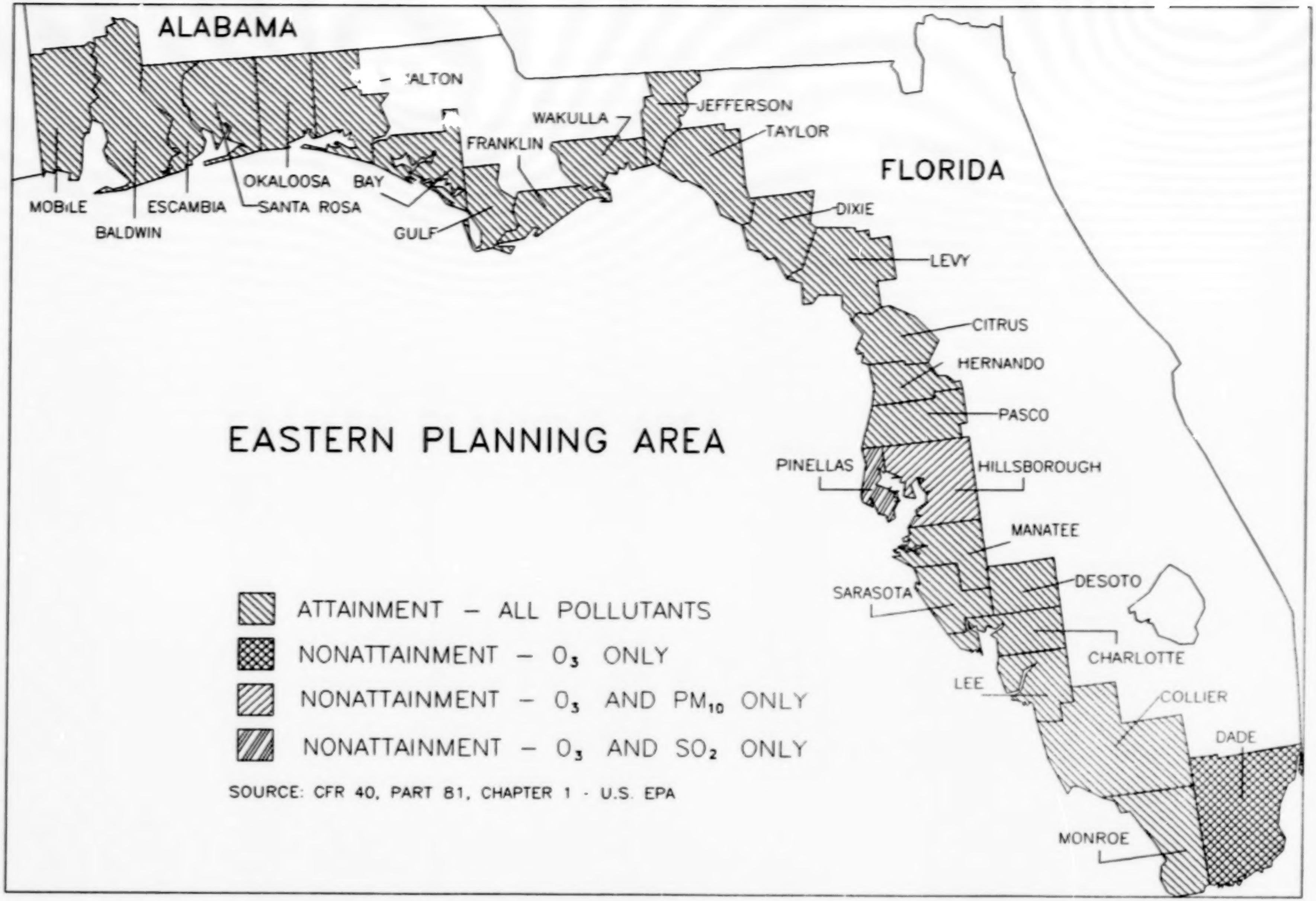
Note: mg/m^3 = milligrams per cubic meter.
ug/m^2 = micrograms per square meter.
ug/m^3 = micrograms per cubic meter.

Source: 40 CFR 50, 1988, and Florida Dept. of Environmental Regulation, 1987a.



SOURCE: CFR 40, PART 81, CHAPTER 1 - U.S. EPA

Figure III-1: Status of Air Quality in the Western and Central Planning Areas of the Gulf of Mexico .



SOURCE: CFR 40, PART 81, CHAPTER 1 - U.S. EPA

Figure III-2. Status of Air Quality in the Eastern Planning Area of the Gulf of Mexico.

Table III-2

Nonattainment and PSD Class I Areas throughout the Gulf Coastal Region

Nonattainment Areas	PM 10	SO_2	O_3	CO	NO_2
Eastern Gulf of Mexico					
Florida					
Hillsborough County	XX		X		
Pinellas County		R	X		
Dade County			X		
Central Gulf of Mexico					
Louisiana					
St. John the Baptist Parish			X		
Orleans Parish			X		
Jefferson Parish			X		
St. Bernard Parish			X		
St. Charles Parish			X		
Lafourche Parish			X		
St. Mary Parish			X		
Western Gulf of Mexico					
Texas					
Cameron County	X		X		
Nueces County	X				
Galveston County			X		
Brazoria County			X		
Harris County	X		X		
Jefferson County			X		
Orange County			X		

Note:
X = Does not meet primary standards
XX = Does not meet secondary standards
R = Does not meet primary or secondary standards

PSD Class I Federal Areas	
Eastern Gulf of Mexico	
Florida	Chassahowitzha Wilderness Area Everglades National Park St. Marks Wilderness Area
Central Gulf of Mexico	
Louisiana	Breton Wilderness Area
Alabama	None
Mississippi	None
Western Gulf of Mexico	
Texas	None

Source: 40 CFR 81.300.

Climatology

Within the context of the overall meteorological conditions described earlier (Section III.A.2.), the climate, as it pertains to air quality in the coastal area, is briefly described. This description includes weather-behavior variations at selected coastal locations.

The climate of coastal areas surrounding the Gulf of Mexico is typically subtropical with year-round high humidity; long, hot summers; and relatively short, cool winters. While precipitation is experienced throughout the 12 months, the wettest months are in the spring and summer. The driest months are in the fall and winter seasons.

The southwestern Gulf Coast climate of lower Texas is influenced by the warm, moist waters of the Gulf of Mexico and the semiarid inland regions west and southwest of the coast. The northern Gulf Coast of upper Texas, Louisiana, Mississippi, and Alabama experience hot, humid summers and mild winters as a result of their latitude and the dominance of the warm Gulf waters. The eastern Gulf Coast of Florida lies within or near the belt of the subtropical (Bermuda) high, which is the source of northeast trade winds and prevailing westerlies. Warm maritime air from the Atlantic Ocean and the Gulf of Mexico moderates the cold of continental air masses from the northwest.

Climatological data from selected locations around the Gulf Coast are summarized in Table III-3. Annual averages are shown for precipitation, temperature, wind, humidity, and pressure. The Pasquill classification system is sused to descsribe climatological stability. This system uses wind speed and net-radiation balance to determine the atmospheric stability near the ground. An area is unstable when there are high, positive net radiation (warming) and low wind speeds; neutral when there are cloudy skies and high wind speeds; and stable when there are high, negative net radiation (cooling) and light winds. Unstable conditions are the result of good diffusion (high turbulence) in the atmosphere. Stable conditions are the result of poor diffusion (low turbulence) in an area. Four times a year, the atmosphere is typically calm for 2 or more days. For periods of 4 or more days, it is typically calm once every 3 years.

4. Physical Oceanography

The Gulf of Mexico is a semi-enclosed, subtropical sea with an area of approximately 1.6 million km^2. The main physiographic regions of the Gulf basin are the continental shelf (including the Campeche, Mexican, and U.S. shelves), continental slopes and associated canyons, abyssal plains, and the Yucatan and Florida Straits. The continental shelf width along the U.S. coastline is about 350 km offshore West Florida; 16 km off the Mississippi River; and 156 km off Galveston, Texas. It decreases to 88 km off Port Isabel near the Mexican border. The depth of the central abyss ranges to 4,000 m. The Gulf is unique among the world's mediterranean seas, having two entrances: the Yucatan Strait and the Straits of Florida. Both straits restrain communication from the deep Atlantic waters because of the limited sill depths--1,600 m in the Yucatan Strait and about 1,000 m in the Straits of Florida. A portion of the Gulf Stream system, the parent Loop Current, whose presence and influence are described below, is present in the Gulf. Along the 24,800-km Gulf coastline, 21 major estuaries are found on the U.S. coast. The amount of freshwater input to the Gulf basin from precipitation and a number of rivers--dominated by the Mississippi and Atchafalaya Rivers--is enough to influence the hydrography of most of its northern shelves. However, the basin's freshwater budget shows a net deficit due to the high rate of evaporation.

Sea-surface temperatures in the Gulf, as shown in Figures 9A and 9B of Visual No. 7, range from nearly isothermal (29°C-30°C) in August to a sharp horizontal gradient in January, ranging from 25°C in the Loop core to values of 14°C-15°C along the shallow northern coastal estuaries. August temperatures at 150 m show a warm Loop Current and an anticyclonic feature in the Western Gulf (both about 18°C-19°C) grading into surrounding waters of 15°C-16°C along the slope. The entire pattern is maintained during winter, but warmer by about 1°C. At 1,000 m, the temperature remains close to 5°C year-round.

Surface salinities along the northern Gulf display seasonal variations because of the seasonality of the freshwater input. During months of low freshwater input, deep Gulf water penetrates into the shelf and salinities near the coastline range between 29 and 32 ppt. High, freshwater-input conditions (spring-summer

Table III-3

Climatological Data for Selected Gulf Coast Locations

Location	Precipitation (Annual Average)	Temperature (Mean Annual, Degree F)	Wind Speed (Average Annual Mean)	Humidity (Average Percent)	Barometric Pressure (Average Annual)	Stability Conditions: Annual Percent Unstable	Stability Conditions: Annual Percent Neutral	Stability Conditions: Annual Percent Stable
Corpus Christi, Tex.	30.2	71.0	12.0	89	1,014 mb*	11.0	61.0	28.0
Galveston, Tex.	42.2	69.6	11.0	83	1,015 mb	16.0	61.4	22.6
Lake Charles, La.	53.0	67.9	8.7	90	1,016 mb	23.0	44.0	33.0
Gulfport, Miss.	58.9	68.0	8.0	85	1,016 mb	17.5	47.4	35.1
Pensacola, Fla.	61.2	67.9	8.3	85	1,013 mb	18.0	22.0	60.0
Key West, Fla.	39.7	77.7	11.2	79	1,014 mb	80.0	18.0	2.0

*mb = millibar

Sources: USDC, NOAA, 1961-1986.

months) are characterized by strong horizontal gradients and inner-shelf salinity values of less than 20 ppt (Wallace, 1980; Cochrane and Kelly, 1986).

The vertical distribution of temperature, salinity, oxygen, and phosphate over six subareas of the Gulf are presented in Figure 8 of Visual No. 7. Also shown are the characteristic five major watermasses identified in the Gulf, down to about 1,000 m. This profile arrangement illustrates the influence of the Atlantic Ocean in the Gulf hydrography and the changes in water characteristics brought about by the local climatology and hydrology. The main result is the creation of the Gulf watermass, which is confined to the surface layer through most of the Gulf basin. Intimately related with the vertical distribution of temperature is the thermocline, defined as the depth at which the temperature gradient is at maximum. During January, the thermocline depth is about 30-61 m in the Eastern Gulf and 91-107 m in the Central and Western Gulf. In May, the thermocline depth is about 46 m throughout the entire Gulf (Robinson, 1973). This depth is important because it demarcates the bottom of the mixed layer and acts as a barrier to the vertical transfer of materials and momentum.

Sharp discontinuities of temperature and/or salinity at the sea surface, such as the Loop Current front or fronts associated with eddies or river plumes, are dynamic features in themselves that may act to concentrate buoyant material such as spilled oil, detritus, or plankton. These materials are not advected by the front's translatory movement, such as Loop Current incursion or the slow westward drift of eddies. The motion consists mainly of lateral movement along the front instead of motion across the front. In addition to open ocean fronts, a coastal front is probably a permanent feature of the Gulf shelf, separating turbid, lower salinity water from the open-shelf regime. Figure 7 of Visual No. 7 indicates that the front lies about 30-50 km offshore. It is not known how strongly this front might affect buoyant material transport.

The Loop Current is a highly variable current feature entering the Gulf through the Yucatan Strait and exiting through the Straits of Florida (as the Gulf Stream) after tracing an arc that may intrude as far north as the Mississippi-Alabama shelf. The Loop consists of ascending and descending 30-km-wide bands of rapidly moving water enclosing a relatively quiescent inner region, and the entire feature may be clearly seen in hydrographic sections down to about 1,000 m. Below that level, there is evidence of a countercurrent. The volumetric flux of the Loop has been estimated at 30 million m^3s^{-1}. Velocities up to 300 cms^{-1} have been measured, but a range of 100-200 cms^{-1} is probably representative.

The "location" of the Loop Current is definable only in statistical terms, due to its great variability. Figure 5A of Visual No. 7 shows the relative existence probabilities for Loop Current water throughout the Eastern Gulf in March, the month of apparent greatest intrusion. Values range from a 100 percent core location at 25°N, down to small probabilities (10%) near midshelf. Figure 5B of Visual No. 7 shows the results of a "wave-staff" analysis, where observed Loop front locations along selected meridional lines are analyzed for central tendency, range, and dispersion. An average northern intrusion is indicated to 26.6°N, within a wide envelope. Both analyses exclude the period June-October due to limitations on satellite data.

The process responsible for the first-order variability of the Loop is the shedding of anticyclonic, warm-water eddies, which may occur when the current is greatly extended. The usual eddies are large, resulting in significant dimensional adjustment by the Loop. This is clearly seen in the data in Figure 5C of Visual No. 7. Processes responsible for smaller, or second-order, variability of the Loop include persistent wind forcing, shelf-edge interactions along the Yucatan Shelf and the West Florida Shelf, and waves along the Loop front associated with the eddy cycle. These instabilities may grow into large intrusions of warm Loop water onto the adjacent shelf and/or entrain colder shelf water into the Loop itself, as seen in Figure 5D of Visual No. 7. Collectively, these processes set up a zone of Loop Current fluctuation extending over the outer shelf, the slope, and the abyssal areas off Mississippi, Alabama, and Florida (MAFLA).

The eddy-shedding cycle has earlier been the subject of much field work and currently of numerical modeling. Based on these data, Figures 1A, 1B, and 1C of Visual No. 7 have been prepared to illustrate the overall cycle, including the subsequent behavior of the eddies. Recent analysis of frontal-positions data indicates that the eddy-shedding period varies between 6.5 and 9.5 months with an average of 7.5 months (Hamilton et al., 1989). Major Loop Current eddies have diameters on the order of 300-400 km and may clearly be seen in hydrographic data to a depth of about 1,000 m. Swirl velocities within the eddies have been reported from 50-200 cms^{-1}. As seen in Figures 4A, 4B, and 4C of Visual No. 7, they move into the Western Gulf along various paths to a region between 25°N-28°N and 93°W-96°W. The eddies move at speeds ranging from 2-5 kmd^{-1}, decreasing in size as they mix with resident waters. The life of an individual eddy to its eventual assimilation by regional circulation patterns in the Western Gulf is about 1 year.

Eddy-shedding from the Loop Current is the principal mechanism coupling the circulation patterns of the eastern and western parts of the basin. The heat and salt budgets of the Gulf are dependent on this importation, balanced by seasonal cooling and river input, and probably also by internal, deeper currents that are poorly understood. These currents may be evident in intriguing hints of abyssal bottom scour and the reversed currents beneath the Loop itself. The eddies are frequently observed to affect local current patterns along the Louisiana/Texas slope, hydrographic properties, and possibly the biota of fixed platforms or hard bottoms. There is some evidence that these large reservoirs of warm water play some role in strengthening tropical cyclones when their paths coincide.

Smaller anticyclonic eddies have been observed to be generated by the Loop Current, although it is not known if the process is merely a scaled-down version of the above cycle. They have diameters on the order of 100 km, but the few data available indicate a shallow hydrographic signature on the order of 200 m. Their observed movements indicate a tendency to translate westward along the Louisiana/Texas slope. Some are included in the analysis presented in Figure 4B of Visual No. 7. Similar in size, cyclonic eddies are observed in the Eastern Gulf, associated with the eddy-shedding cycle, and along the Louisiana/Texas slope. Their genesis and role in the overall Gulf circulation are not well studied. A major cyclonic eddy seems to be resident in the southwestern Gulf, based on older data synthesis; however, some recent evidence points toward a more complex, less homogeneous structure.

Three studies have attempted to quantify the open Gulf circulation. Figure 2A of Visual No. 7 displays the results of calculating the mean surface topography from all expendable bathythermograph and Nansen cast data from the National Oceanographic Data Center (NODC), carefully edited. Figure 2B of Visual No. 7 displays the mean surface elevation from a 3-year simulation with the same model as Figures 1A, 1B, and 1C of Visual No. 7, including wind forcing. All figures generally agree on the Loop Current region and an anticyclonic high in the Western Gulf, with some minor disagreement on details. Figure 2C of Visual No. 7 translates the mean surface elevations of Figure 2B of Visual No. 7 into surface-current vectors, illustrating the interpretation of topographic contours. Although the mean surface topography may be considered to represent the mean surface circulation of the Gulf, it has little utility for reasons discussed below.

The regions of greatest variability in surface-contour analyses represent the regions of greatest current variability in the Gulf. These are areas where the use of long-term average currents could lead to misleading results in calculations of oil-spill trajectories. The errors result from the fact that mean speeds are not representative of the prevailing circulation. The studies depicted in Figures 2A and 2B of Visual No. 7 have been analyzed to yield variability surfaces. Figure 3A of Visual No. 7 shows the variability from the hydrographic study, emphasizing the zone of eddy detachment from the Loop centered about 26.5°N and 88.5°W. Figure 3B of Visual No. 7 shows the variability from the modeling study, emphasizing a broad eddy detachment zone, a zone centered about 23°N and 94.5°W where many eddies go initially, and the zone identified in Figure 2B of Visual No. 7. Figure 3C of Visual No. 7 displays the results of direct measurements of surface variability from satellite altimeters.

Aside from the wind-driven surface layer, current regimes on the outer shelf and slope are the result of balance between the influence of open Gulf circulation features, such as the Loop and eddies, and the shelf circulation proper, which is dominated by long-term wind forcing. A western boundary current, driven both by prevailing winds and the semipermanent anticyclonic eddy, occurs offshore northern Mexico and South Texas. A strong east-northeasterly current along the remaining Texas and Louisiana slope has been explained partly by the effects of the semipermanent, anticyclonic eddy and a partner cyclonic eddy ("modon pair") and partly by the mass-balance requirements of eddy movement. Within the Loop Current fluctuation zone, offshore the MAFLA states, the intrusion of the Loop front or the presence of minor detached eddies sets up short-term strong currents, but no permanent current has been identified other than a weak statistical residual. When the Loop Current impinges onto the Florida slope and shelf, it has been observed that the current structure acts to upwell nutrient-rich water from deeper zones, a mechanism that may also take place as eddies move along the Louisiana/Texas slope, accounting for the increased productivity recognized in these areas. West of approximately Cameron, Louisiana (93°W), current measurements clearly show a strong response of coastal current to the winds, setting up a large-scale, anticyclonic gyre. The inshore limb of the gyre is the westward or southwestward (downcoast) component that prevails along much of the coast, except in July-August. Because the coast is concave, the shoreward prevailing wind results in a convergence of coastal currents at a location where the winds are normal to the shore or at the downcoast extent of the gyre. A prevailing countercurrent toward the northeast along the shelf edge constitutes the outer limb of the gyre. The convergence at the southwestern end of the gyre migrates seasonally with the direction of the prevailing wind, ranging from a point south of the Rio Grande in the fall to the Cameron area by July. The gyre is normally absent in July but reappears in August-September when a downcoast wind component develops (Cochrane and Kelly, 1986).

The Mississippi/Alabama shelf circulation is controlled by the Loop Current, winds, tides, and freshwater input. During intrusions of the Loop into the shelf, the Loop will completely dominate the shelf circulation; when located offshore, the Loop may drive a counter-clockwise circulation. Tidal currents of 15 cms^{-1} have been observed in this area (Vittor and Associates, Inc., 1985). The general circulation is a two-season event. During winter, the water column is homogeneous and surface circulation is mainly alongshore and westward at mean speeds of 4-7 cms^{-1}. The cross-shelf component is smaller and directed onshore. During spring-summer conditions, the surface flow is mostly eastward with mean speeds in the range of 2-7 cms^{-1}. However, during periods of sustained winds from the west, northwest, north, and northeast, near-bottom speeds average 20 cms^{-1} in water depths of 20 m. With sustained winds from the southeast, south, and southwest, the near-bottom average speed increases to 26 cms^{-1}. Under winds with easterly components, the water tends to flow shoreward and accumulate against the shoreline, creating a pressure gradient that drives bottom water alongshore in the direction of the winds (Vittor and Associates, Inc., 1985).

The West Florida shelf circulation is dominated by tides, winds, eddy-like perturbations, and the Loop Current. Tidal currents are slightly dominated by diurnal components with speeds of about 5 cms^{-1} at spring tides. The wind-driven flow is mostly alongshore and parallel to the isobaths at water depths less than 30 m. The mean flow is directed southward with mean speeds ranging from 0.2-7 cms^{-1} in the surface layer. Near the shelf edge the flow is onshore from surface to mid-depth and offshore below. The mean onshore speeds are 0.4-3 cms^{-1}, and the general offshore speeds are less than 1 cms^{-1}. The Loop influence is by direct or indirect forcing by the intrusions and meanders. This influence is felt most strongly along the shelf break and slopes. The actual circulation is composed of several components of different frequencies of which the 10-14 days component contains a large fraction of the variance. Wind-driven events induce horizontal particle excursions, which are proportional to the period of the event; thus, longer periods cause longer particle excursions (SAIC, 1986).

Longshore currents, consisting of tidal, wind-driven, and density-gradient components, predominate over across-shelf components within a narrow band close to the coast (on the order of 10-20 km, referred to as the coastal boundary layer). Typical maximum tidal currents within this band would be about 15 cms^{-1}. These currents will cause a particle displacing, known as the tidal excursion, at 2-3 km. Currents, driven by synoptic-scale winds, range up to 25-50 cms^{-1} for nonextreme conditions, with 10- to 100-km excursions expected for a typical 5-day "wind event." Longshore currents due to winter northers, tropical storms, and hurricanes may range up to hundreds of cms^{-1}, depending on local topography, fetch, and duration. Should an oil spill occur, deviations from results predicted by open-ocean models could happen at coastal fronts, where concentration and lateral translation could occur, and within the longshore-current zone, where significant transport away from the "expected" point of contact could occur, as determined by local tidal phase and predominant winds.

Studies of surface drifters are useful and illustrative in the study of oil movement because, hopefully, surface slicks will respond to currents in a similar way. A summary of drifter studies across the Gulf (Parker et al., 1979) indicated that the Texas coastline and the southern and eastern Florida coastlines receive the most landings. Other coastlines along the Gulf received very small numbers of landings. A study along the Florida west coast (Williams et al., 1977) found that during fall and winter most reports were from south and eastern Florida. During the spring and summer, the lower west, south, and eastern Florida coastline received similar landings. Strangely, during summer and fall, the Louisiana and Texas coastlines received sizable fractions of the landings.

Figures 6A, 6B, 6C, and 6D of Visual No. 7 show the seasonal mean winds from a multiyear analysis. An annual cycle of wind direction is indicated: winter winds from the east-northeast; spring winds from the southeast; summer winds from the southeast and south; and fall winds shifting back to the east-northeast. The distribution of wind speeds is shown in Figure 6G of Visual No. 7. Western summer winds have a mode at 4-6 ms^{-1}, compared to 2-4 ms^{-1} in the Eastern Gulf. Winter winds are stronger in both regions, principally in the 8-10 ms^{-1} interval, which may be due to cold fronts transiting the southeastern United States every 3-10 days in the fall and winter. Not reflected in the wind climatology are the much stronger winds associated with tropical cyclones that frequently move through the greater Caribbean area. The classes of cyclones, and their defining minimum wind speeds, are as follows: tropical depression (up to 16 ms^{-1}); tropical storm (17-31 ms^{-1}); and hurricane (32 ms^{-1} or more). Figure 6E of Visual No. 7 gives the probabilities that at least one cyclone in the storm or hurricane category will occur in a defined zone in a given year.

A summary of significant wave-height measurements, based on a multiyear analysis, is presented in Figure 6G of Visual No. 7. Western summer waves tend to be smaller than those in the Eastern Gulf; waves in both regions intensify in winter, with the Western Gulf showing a clear mode at 2-3 m. Not reflected in these results are the much larger waves associated with hurricanes. Figure 6F of Visual No. 7 displays the hindcast significant wave heights for several hurricanes since the onset of offshore development, indicating a range of about 6-12 m for open shelf waves. Also displayed are expected 100-year maximum wave heights, which could range to 21+ m.

5. Chemical Oceanography

Regional Overview

The discussion that follows heavily emphasizes hydrography and the productivity aspects of classical chemical oceanography. Process-oriented material is not presented, as no unique mechanisms are known to prevail in the Gulf of Mexico.

The Gulf enjoys the benefit of having been the subject of a number of regional- or basin-scale studies emphasizing chemistry of the water column, and of several valuable reviews. The material synthesized below is derived from an extensive library of sources, some of which are identified by specific information.

Due to the ambience of the medium, space scales far greater than those considered relevant in biological considerations apply to chemical oceanographic assessment. Watermass characterizations are generally applicable at scales on the order of 1,000 km, while processes related to mesoscale-circulation patterns, such as primary production, probably should be described in terms of 100-km scales. For these reasons, the following description is organized to proceed from greater to lesser scales as the emphasis shifts from nearly conservative basinwide characteristics to regionally variable, inshore/offshore parameters.

The Gulf of Mexico is a semienclosed system with oceanic input through the Yucatan Channel and principal outflow through the Straits of Florida. Runoff from approximately two-thirds of the area of the United States and more than one-half the area of Mexico empties into the Gulf. This large amount of runoff, with its nonoceanic composition, is mixed into the surface water of the Western Gulf and makes the chemistry of parts of this system quite different from that of the open ocean. For a discussion of Gulf circulation patterns, see Section III.A.4.

Mixed-Layer Hydrography

Salinity: The mixed layer, extending down to a depth of approximately 100-150 m, is characterized by salinities between 36.4 ppt and 36.5 ppt in the open Gulf. Salinity values in shelf and estuarine regions may vary widely from this range due to the opposing effects of river input and enhanced evaporation. Alternating floods and droughts may cause salinity changes from nearly fresh to 100 ppt, three times that of normal seawater. These variations can lead to mass mortality of marine organisms (Caruthers, 1972; Corcoran, 1973; Nowlin, 1972).

Temperature: In the Eastern Gulf, maximum surface temperatures range from 27°C in late winter to about 30°C in the summer. A range of 22°C-29°C is observed in the Western Gulf; the difference reflects the steadying influence of the Loop Current (Corcoran, 1973; Dames and Moore, 1979; Flint and Rabalais, 1980; Ichiye et al., 1973; Nowlin, 1972; SUSIO, 1977 and 1978; Williams, 1954; Woodward-Clyde Consultants, 1982). The lowest values encountered may range as low as approximately 10°C in the Louisiana-Mississippi shelf region at times of extraordinary snowmelt in the upper Mississippi valley.

Oxygen: Dissolved oxygen values in the mixed layer average about 4.6 ml/L, with certain seasonal variation, particularly a slight lowering during the summer months. Oxygen values generally decrease to about 3.5 ml/L, with depth through the mixed layer (Caruthers, 1972; Corcoran, 1973; Nowlin, 1972; Williams, 1954).

Watermass Hydrography

Eight specific watermasses are recognized to occur in the Gulf (Table III-4).

Exotic Waters

Hypersaline Basins: Two basins containing hypersaline waters have been identified. Salinities as high as 196 ppt at a small pool on the East Flower Garden topographic high and 250 ppt in the Orca Basin have been measured (Rezak et al., 1985; Addy and Behrens, 1980). Unique regimes may be present at these sites due to the partial absence of oxygenated chemical species.

Midshelf Freshwater Vents: At a number of sites on the southwest Florida shelf, submarine springs are present, found in association with extensive karst topography. Little is known about the chemical regime of the associated biota within these features.

Micronutrients

Nutrient Cycling: The principal micronutrients about which generalizations can be drawn, based on the limited data available, are phosphate, nitrate, and silicate. Phytoplankton consume phosphorus and nitrogen, principally via their ionic species, in an approximate ratio of 1:16 for growth. Silicon is consumed for production of skeletal structures, particularly by diatoms, which are present in enormous numbers in Gulf waters. Mineralization of dead plankters returns the nutrients to the water column, although typically at a greater depth than that of initial assimilation, due to sinking.

Mixed-Layer-Distribution Patterns: Phosphates range from 0 to 0.25 ppm, averaging 0.021 ppm. Shelf values do not differ significantly from open Gulf values. Integrated Eastern Gulf values are somewhat lower than Central and Western Gulf values. Silicates range predominantly from 0.048 to 1.9 ppm. Open Gulf values tend to be lower than shelf values. Integrated Eastern Gulf values are again somewhat lower than Western Gulf values. Nitrates range from 0.0031 to 0.14 ppm, averaging 0.014 ppm. Open Gulf values are slightly higher than shelf values. There is no clear pattern in depth-integrated values between regions (Corcoran, 1973; Dames and Moore, 1979; Flint and Rabalais, 1980; Ichiye et al., 1973; Nowlin, 1972; SUSIO, 1977 and 1978; Williams, 1954; Woodward-Clyde Consultants, 1982).

Vertical Distribution: Vertical distributions of nutrients show five general features related to both the identified watermasses and the biological activity: (a) low concentration in the mixed layer (to 100 or 200 m); (b) substantial increase from 200 m to 700 or 800 m; (c) maximum values at approximately 800-1,000 m; (d) small decreases in concentration below 1,000 m; and (e) homogeneous concentrations below about 1,500 m. At the maxima, phosphate concentrations range from 0.14 to 0.23 ppm, silicates from 1.9 to 2.3 ppm, and nitrates from 1.8 to 2.1 ppm (Corcoran, 1973; Dames and Moore, 1979; Flint and Rabalais, 1980; Ichiye et al., 1973; Nowlin, 1972; SUSIO, 1977 and 1978; Williams, 1954; Woodward-Clyde Consultants, 1982).

Particulate and Optical Parameters

Biological primary production in the Gulf is critically dependent on both chemical and physical factors. The driving photosynthetic mechanism is light-limited; and, due to attenuation processes in the water column, it is ineffective below an average depth of about 75 m, where incident light has been reduced to about 1 percent. The most highly variable component of total light-field attenuation in the water column is the scattering induced by suspended particles, both organic and inorganic. Particles also act as substrates for bacterial activity, transport loci for absorbed species, and act as physical irritants to sensitive biological species. Open Gulf waters have particulate loads ranging from about 0.1 to 0.2 ppm. Over 50 percent of the suspended particulate matter is organic in surface waters, decreasing to about one-third in deeper waters. The inorganic fraction is composed largely of clay minerals, reflecting the importance of the Mississippi River as a source (Hedges and Parker, 1976).

A common phenomenon in the Gulf, especially on the shelf, is the local presence of greatly elevated levels of suspended material, with values above 1 ppm. Typically, near-bottom layers of turbid water are encountered and are separated from overlying waters by sharp discontinuities. These "nepheloid" layers may

Table III-4

Water Mass Characteristics in the Gulf of Mexico

Water Mass	Extreme	Concentrations	Depth Range (m)	Location
Gulf Water	**Salinity maximum**	**36.4-36.5 ppt**	**0-250**	**Gulfwide**
Subtropical Underwater (SUW)	**Salinity maximum**	**less than 36.8 ppt**	**100-300**	**Eastern Gulf***
18° Sargasso Seawater 18° SSW	**Oxygen maximum**	**(small and variable)**	**200-400**	**Eastern Gulf***
Tropical Atlantic Central Water	**Oxygen minimum**	**2.5-2.9 ml/l**	**250-400**	**Gulfwide**
Antarctic Intermediate Water	**Nitrate maximum**	**29-35 ug-at/l**	**500-700**	**Gulfwide**
Antarctic Intermediate Water	**Phosphate maximum**	**1.7-2.5 ug-at/l**	**600-800**	**Gulfwide**
Antarctic Intermediate Water	**Salinity maximum**	**34.88-34.89 ppt**	**700-800**	**Gulfwide**
Mixture of North Atlantic Deep Water and Caribbean Mid-Water	**Silicate maximum**	**24-28 ug-at/l**	**1,000-1,100**	**Gulfwide**

***SUW may occasionally be found in the Western Gulf in eddies detached from the Loop Current. There have also been indications of 18° SSW in detached eddies, but the evidence is slight.**

Sources: Barnard and Froelich, 1981; Caruthers, 1972; Corcoran, 1973; El-Sayed, 1972; Iverson and Hopkins, 1981; Nowlin, 1972; SUSIO, 1977 and 1978; Williams, 1954; Woodward-Clyde Consultants, 1982.

be associated with resuspension by bottoms currents, internal waves, intense at-depth biological activity, or a complex combination of these factors. These features appear to occur naturally at nearly all locations on the shelf and upper slope environment, excepting the promontories of significant topographic highs.

Primary Production

Productivity Measurements

Regional Distribution: Primary production, the conversion of mineralized nutrients to living phytoplankton tissue as measured by C^{14} uptake, occurs predominantly at the low level of 0.25 m^C/m^3/hr or less throughout the Gulf. Higher levels, between 0.25 and 1.0 units, are found at northeastern and southern locations, with maximum values on the Yucatan shelf. In terms of depth-integrated values, western regions seem to be more productive than the eastern regions (Barnard and Froelich, 1981; El-Sayed, 1972; Iverson and Hopkins, 1981; LaRock and Bittaker, 1973; Williams, 1954).

Depth Distribution: Higher productivity levels are sustained at subsurface levels rather than at the surface. Maximum C^{14} assimilation generally occurs at depths corresponding to 50-25 percent of surface-light intensity (Barnard and Froelich, 1981; El-Sayed, 1972; Iverson and Hopkins, 1981; LaRock and Bittaker, 1973; Williams, 1954).

Seasonal Distribution: Unlike temperate or high-latitude waters where the amplitude of the seasonal variations in productivity is manifold, the amplitude in the Gulf is very much damped. The ratio of maximum (winter) to minimum (spring) integrated productivity is approximately 2:1 (Barnard and Froelich, 1981; El-Sayed, 1972; Iverson and Hopkins, 1981; LaRock and Bittaker, 1973; Williams, 1954).

Chlorophyll Measurements

Regional Distribution: The distribution of chlorophyll closely parallels that of productivity. Most values range from 0.05 to 0.30 mg/m^3 (ppb), with highest values found off the Mexican coast. In terms of depth-integrated values, the region of the Loop Current seems to show higher values for chlorophyll than the Central and Western Gulf (Barnard and Froelich, 1981; El-Sayed, 1972; Iverson and Hopkins, 1981; LaRock and Bittaker, 1973; Williams, 1954).

Depth Distribution: Maximum chlorophyll concentrations occur very deep within the portion of the water column where the light exceeds 1 percent of surface insolation, the euphotic zone. In some cases, maxima are found below the euphotic zone, possibly reflecting sinking plankters. Secondary peaks of chlorophyll above the maximum may be associated with thermal gradients in the water column.

Seasonal Distribution: Maximum (winter) depth-integrated values for chlorophyll exceed minimum (fall) values only by a factor of about 1.2 (Barnard and Froelich, 1981; El-Sayed, 1972; Iverson and Hopkins, 1981; LaRock and Bittaker, 1973; Williams, 1954).

Total Production

Average depth-integrated primary productivity in the Gulf is about 0.1 g^C/m^2/day, for an annual production of 17 g^C/m^2/day. This value is about one-half the average for all the world's seas and one-half to one-fourth the value for the western-central Atlantic. Annual total production for the Gulf is about 43 million metric tons of carbon (Barnard and Froelich, 1981; El-Sayed, 1972; Iverson and Hopkins, 1981; LaRock and Bittaker, 1973; Williams, 1954). Assuming a carbon content of 50 percent in the biomass, a gross annual production of 86 million metric tons can be calculated.

Central Gulf of Mexico

Estuarine and Inner Shelf

Hydrography and Nutrient Chemistry: This area is strongly influenced by the presence of America's major river, the Mississippi, as well as a host of other major drainage systems. A complex geography of sounds and bays protected by barrier islands and extensive tidal marshes acts to delay mixing, resulting in extensive areas of mesohaline (middle salinity) conditions. Turbidity is normally quite high, with suspended sediments up to 1-10 mg/1, primarily composed of clay minerals. The salinity gradients established in estuarine areas are extremely important for the maintenance of finfish and shellfish production; thus, enormous fluctuations in harvest may occur paralleling annual hydrology (Barrett et al., 1971; Christmas and Eleuterius, 1973; Gallaway, 1981; SUSIO, 1977 and 1978; Woodward-Clyde Consultants, 1982).

In general, Louisiana's estuaries and open nearshore waters are low in salinity and high in nutrient concentrations as compared with other states bordering the northern Gulf. These characteristics are due primarily to Louisiana's high rainfall and the large volume of river water that makes its way through rich alluvial soils to the Gulf of Mexico. The major contributors of nutrients to the estuaries are the Mississippi and Atchafalaya Rivers (Barrett et al., 1971; Christmas and Eleuterius, 1973; Gallaway, 1981; SUSIO, 1977 and 1978; Woodward-Clyde Consultants, 1982).

The Mississippi River input acts to create a lens of fresher, more turbid water, often curling to the west. Hydrographic studies, suspended-sediment characteristics, and sensitive chemical analyses demonstrate its influence as far west as South Texas. Of importance is the water-column stratifying effect of this fresh lens on nearshore waters. It is frequently observed during summer months, particularly August, that hypoxic bottom-water conditions exist on the central Louisiana shelf in zones that may extend over 50 km along shore-normal transects. Mass mortality of organisms and characteristic chemical changes also occur. These conditions have serious implications for the continued viability of the local fisheries and for monitoring programs of any sort (Boesch and Rabalais, 1987).

Primary Production: As a probable consequence of the large fluvial input of nutrients, the Louisiana nearshore shelf is considered one of the most productive areas of phytoplankton in the Gulf. Integrated chlorophyll values are two times average Gulf values, and integrated production values range an order of magnitude greater than the Gulf average (Barrett et al., 1971; Christmas and Eleuterius, 1973; Gallaway, 1981; SUSIO, 1977 and 1978; Woodward-Clyde Consultants, 1982).

Outer Shelf and Slope

Hydrography and Nutrient Chemistry: Less is known about the central area than other zones. Observations indicate that the effects of the Mississippi are felt here, although much reduced by distance. Hypoxic bottom waters are not reported, although surface freshening occurs at times of maximal discharge. Upwelling of cooler, nutrient-rich waters onto the shelf is known, but the mechanism is not fully understood since regional circulation patterns remain unclear. The passage of detached, anticyclonic eddies toward the west may be important in this regard. The water column is frequently observed to contain turbid layers associated with interfaces between two or three distinct water layers. A Mississippian origin is suggested for these layers (Gallaway, 1981; Southwest Research Institute, 1981).

Primary Production: No studies characterizing this specific region have been identified . It is believed that values for productivity and chlorophyll approach Gulf averages, but that circulation events, such as the transient effects of passing eddies, might play a role in enhancing these values (Gallaway, 1981; Southwest Research Institute, 1981).

Western Gulf of Mexico

Estuarine and Inner Shelf

Hydrography and Nutrient Chemistry: Nutrient concentrations are generally representative of open-Gulf surface waters, but continental runoff influences nearshore surface concentrations, especially in spring. Nutrients are reduced to extremely low values after spring and summer blooms but are replenished in the fall (Caillouet et al., 1981; Flint and Rabalais, 1980; Gallaway, 1981).

The water column over the inner shelf is very nearly isothermal during the fall, winter, and spring months, showing a slight stratification only in summer. Temperatures characteristic of the mixed layer over the inner Texas shelf range from approximately 11°C-13°C in late summer. Salinities range from open-Gulf surface values of about 36.4 ppt to 20 ppt or less during the spring runoff or during heavy rainfall. A bottom nepheloid layer is nearly always observed (Caillouet et al., 1981; Flint and Rabalais, 1980; Gallaway, 1981).

Primary Production: Chlorophyll is highly correlated with salinity decreases in this area, indicating the influence of riverine input. The local input from Texas rivers is the major source of freshwater nutrients and turbidity in the region. These effects decrease with distance from shore. Most chlorophyll is found at the bottom of the water column, from the shore out to mid-shelf (Caillouet et al., 1981; Flint and Rabalais, 1980; Gallaway, 1981).

Outer Shelf and Slope

Hydrography and Nutrient Chemistry: Beyond the nearshore region of heavy influence by Texas rivers, the effects of the Mississippi River are more obvious. Although salinity variations are seen to respond to Mississippian input, nutrients do not correspond as closely, due perhaps to some depletion during transit. Overall, the nutrient values are somewhat lower than inshore values. The intrusion of nutrient-rich, oxygen-poor water from apparent depths of 200-300 m is indicated in many cases, with effects seen all the way up to 70 m in depth. An area of major upwelling has been indicated along the shelf break (Flint and Rabalais, 1980; Gallaway, 1981; McGrail et al., 1978).

Primary Production: Productivity on the outer shelf exhibits much less variability, which can be ascribed to riverine input. Chlorophyll values in this area average less than inshore areas, as expected, but an inverse relation with salinity is not found. Aperiodic upwelling events are probably of primary importance in regulating offshore production in this area (Flint and Rabalais, 1980; Gallaway, 1981; McGrail et al., 1978).

Eastern Gulf of Mexico

Estuarine and Inner Shelf

Hydrography and Nutrient Chemistry: The major influence on this zone is atmospheric forcing combined with the seasonal input from fluvial sources. Pockets of high salinity (> 36.8 ppt) may be found on the bottom, possibly produced by enhanced evaporation during the summer. It is very rare for Loop Current waters to intrude landward of the 20-m contour, bringing nutrient-rich waters. In general, resident waters remain nutrient deficient with the exception of the immediate vicinity of estuaries. Oxygen values are at or near saturation, and profiles show little structure. Extraordinary blooms of pathogenic phytoplankton, known as "red tide," may occur on the mid- to inner-shelf. These outbreaks may be associated with rare Loop Current intrusions, nutrient flux from estuaries, or both (Corcoran, 1973; Dames and Moore, 1979; Ichiye et al., 1973; LaRock and Bittaker, 1973; SUSIO, 1977 and 1978; Woodward-Clyde Consultants, 1982).

Primary Production: Outside the estuaries, productivity values generally are low.

Outer Shelf and Slope

Hydrography and Nutrient Chemistry: The major influence in this zone is undoubtedly the pervasive influence of the Loop Current. It is fairly well-established that the Current acts to pump nutrient-rich, deeper waters up onto the shelf. This mechanism acts most demonstrably during the passage of frontal eddy structures and may be reinforced by wind-driven upwelling. Near-bottom increases in particle content are a usual condition, but the explanation consists of a complex summation of occasional bottom-current effects and enhanced productivity at depth. Watermasses present range from surface mixed-layer characteristics to upwelled, subtropical underwater (SUW) characteristics (Corcoran, 1973; Dames and Moore, 1979; Ichiye et al., 1973; LaRock and Bittaker, 1973; SUSIO, 1977 and 1978; Woodward-Clyde Consultants, 1982).

Primary Production: Both chlorophyll and productivity values at the surface are normally low in this area, with the significant exception of patches of enhanced activity occurring within the upwelled parcels of colder waters found in cyclonic circulation cells associated with Loop Current frontal eddies. Chlorophyll and productivity values about an order of magnitude greater are probably the usual condition near the bottom of the euphotic zone due to the often intruded, nutrient-rich Loop undercurrent waters (Corcoran, 1973; Dames and Moore, 1979; Ichiye et al., 1973; LaRock and Bittaker, 1973; SUSIO, 1977 and 1978; Woodward-Clyde Consultants, 1982).

6. Water Quality

Definition

The water quality of a water body is a measurement of the chemical and physical characteristics of a water-mass that describe its suitability for specific uses. Degradation of water quality occurs when it is contaminated by chemical, biological, or radiological substances in a form that can be incorporated into and harm or otherwise contaminate aquatic organisms, consumers of aquatic organisms, or users of the aquatic environment. The health of a water body is assessed by measuring certain indicator constituents where it is known that, when threshold concentrations are exceeded, one or more uses served by the water body are lost or diminished. Often, the contaminant uptake by indicator organisms or the health or productivity of living marine systems are measured in place of, or in conjunction with, a direct measurement of indicator water characteristics.

Coastal waters are defined as inshore waters within the geographical area defined by each state's coastal zone management program. Nearshore waters are defined as offshore open waters that extend from the shoreline out to the limits of the territorial seas (12 nautical miles).

A description of offshore water quality (OCS waters) is provided by the description of the chemical oceanography of the Gulf (Section III.A.5.). Also, the section describing major sources of oil contamination in the Gulf of Mexico (Section IV.C.4.) provides information on levels of hydrocarbon pollution in offshore waters.

Nearshore and coastal waters that may be adversely affected by a change in water quality provide habitat for fish, shellfish, and wildlife; and they aid in the growth of coastal wetlands, coral reefs, and seagrasses. Such waters may also serve as municipal and private water supplies for recreational and commercial fisheries and for human recreation activities in and on the water. The perception of degraded water quality is directly tied to the use of the water body. What constitutes an acceptable measure of water quality to individuals or institutions depends on what aspects of the environment they value, use, manage, or protect. Any change in the pristine characteristics of aquatic preserves, for example, may be viewed as pollution; whereas, in the case of recreational boating operations, polluted waters may not be perceived by the users until the assimilative capacity of the waters is exceeded and the waters become foul. More stringent water-quality standards are sometimes set when the water body is identified as deserving special protection, such as NOAA's designated National Estuarine Research Reserves in Apalachicola and Rookery Bays in Florida and in Weeks Bay in Alabama (USDC, NOAA, 1989b) or Florida's program of "Outstanding Florida Waters" (Florida Dept. of Environmental Regulation, 1987b). To complicate the task of identifying degraded water quality, water bodies identified as requiring special consideration can be either pristine waters or extremely stressed waters.

Pollutants Measured

Parameters usually measured to characterize nearshore and coastal water quality include salinity, biochemical oxygen demand (BOD), chemical oxygen demand, petroleum hydrocarbons (oil and grease), total suspended solids, total dissolved solids, nutrient loadings, heavy and trace-metal concentrations, coliform bacteria, synthetic organics, tributlytins from marine paints, toxic substances and hazardous wastes, radionuclides, toxins, and solid wastes (trash). These parameters must be assessed in the context of the natural components of the water system such as substrate, suspended particulates, and current patterns and circulation. For instance, water quality in an estuary is a function of freshwater flow, the quantities of nutrients brought with this flow, and the degree of mixing in the estuary.

Salinity is an important parameter because it affects the distribution of marsh vegetation and benthic macroinvertebrates. Saltwater intrusion is defined as the introduction, accumulation, or formation of saline water in a water of lesser salinity (Texas Water Commission, 1986). The States of Texas and Louisiana have identified saltwater intrusion as a major water-quality concern (Texas Water Commission, 1986; Louisiana Dept. of Environmental Quality, 1988).

Biochemical and chemical oxygen demand and the concentration of dissolved oxygen are measured because they are good indicators of a stressed environment. Biochemical oxygen demand serves as an indicator of the organic pollution occurring in the water (Stoker and Seager, 1976). It is the measure of the amount of molecular oxygen used by bacteria for the oxidation of organics contained in waters. Coastal counties/parishes where BOD discharges (high amounts of organic matter) are the greatest include Harris, Jefferson, and Nueces, Texas: East Baton Rouge and Calcasieu, Louisiana; and Mobile, Alabama (USDC, NOAA, 1985). Low dissolved oxygen usually occurs in the summer due to a combination of higher than normal nutrient or oxidizable organic-matter levels (such as sewage effluent), high water temperatures, high benthic metabolic rates, low light penetration, and weak winds that result in density stratification within the water body. Low dissolved-oxygen levels, called hypoxia, and anoxia have been measured in recent years in Gulf Coast estuaries and along portions of the inner continental shelf. The most severe and repeated occurrences of hypoxia are in areas altered by man, such as marinas and ship channels. Estuaries where hypoxia has been noted include Sarasota and Hillsborough Bays on the Florida coast; Perdido Bay, Mobile Bay, Mississippi Sound, Pascagoula Bay, Biloxi Bay, Lake Pontchartrain, and Calcasieu Lake, all on the northern Gulf Coast; and Sabine Pass, Galveston/East/West Bays, Corpus Christi/Nueces Bays, and Lower Laguna Madre on the Texas coast. Mobile Bay is unique in that it has become hypoxic in the winter (USDC, NOAA, 1985). Hypoxia also seems to be a recurrent summer phenomenon in bottom waters off Louisiana's inner continental shelf. Occasionally this phenomenon extends westward, at least to Freeport, Texas. This hypoxia, although not totally understood, is linked to density stratification due to late-spring river discharges and inorganic and organic nutrient inputs (Boesch and Rabalais, 1987).

Concentrations of suspended-sediment and organic matter influence water turbidity and therefore the degree of light penetration. Reduced light penetration adversely affects corals, seagrasses, and benthic algae and plants; and it can, in turn, influence primary productivity. Benthic organisms can be harmed by burial when the suspended load settles to the bottom of a water body.

If nutrient levels become too high, harmful eutrophication can occur. This condition usually occurs due to added nutrient inputs by human activities. When waters become eutrophic, algal blooms and excessive aquatic weed growth also can occur; this can lead to fish kills. Excessive plant growth can interfere with recreational use of the waters. Eutrophic waters are unsightly and can be unhealthy to water users due to the high coliform bacteria often associated with nutrient enrichment. Estuaries such as Tampa Bay on the Florida coast, Mobile Bay and Lake Pontchartrain on the northern coast, and Galveston Bay on the Texas coast receive large loads of nutrients from local sources and have experienced water-quality problems attributed to such sources.

When the level of heavy metals that normally enter the marine environment through the weathering of the earth's crust is increased by inputs from man's activities, the heavy metals become toxic to most organisms, including humans. Once ingested, they exert harmful toxic effects through inhibiting enzymes and biochemical processes. Thirteen heavy metals are listed by the USEPA on its priority pollutant list: antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc. Coastal counties/parishes identified as receiving the greatest heavy-metal discharges include Ascension, Louisiana, and Calhoun, Harris, Orange, and Jefferson, Texas. Counties/parishes where lead discharges are the greatest include the above counties as well as St. Charles and Iberville, Louisiana, and Mobile, Alabama (USDC, NOAA, 1985).

Synthetic organic compounds, chlorinated hydrocarbons in particular, are recognized as carcinogens. They accumulate in the fats and tissues of animals, and many are known to bioconcentrate in the food chain. Major human-health concerns relate to ingestion of both contaminated water and organisms contaminated with these compounds. Synthetic organic compounds are known to affect the central nervous system, liver, kidney, and reproductive system of both humans and other organisms. When discharged into marine waters, these compounds adhere to particulate matter and become deposited in bottom sediments. The USEPA has identified 126 priority pollutants (40 CFR 122, Appendix D). Of these, 112 are synthetic organics and 67 are chlorinated hydrocarbons. Of particular concern are the polychlorinated biphenyls (PCB's).

Coliform bacteria is used as an indicator of pathogens, primarily from fecal contamination, since they are found in large numbers in polluted waters. Coliform-bacteria counts are the primary criterion used to approve shellfish areas for harvesting. Unfortunately, they do not always reflect the presence of other pathogens that can survive in marine waters longer than coliform bacteria. Human-health effects of pathogens include typhoid, dysentery, diarrhea, and cholera.

Sources of Pollutants

Monitoring the concentrations of these constituents is important in determining the health of the Gulf's coastal waters. Information on monitoring studies is provided in the next section. However, prevention of the causes of water-quality degradation usually focuses on identifying and regulating the sources of the pollutants. Sources of pollutants in the Gulf's coastal waters include point, nonpoint, and upland sources. Geographical information in the following discussion about sources of pollutants is derived primarily from NOAA's Strategic Assessment Data Atlases that provide selected water-quality characteristics along the Gulf Coast (USDC, NOAA, 1985). Much of this information is being updated by NOAA and will be available next year (Alexander, personal comm., 1989).

Point Sources

Major point sources of contaminants occurring along the Gulf Coast include the petrochemical industry, hazardous-waste sites and disposal facilities, manufacturing-industry activities, fossil fuel and nuclear power-plant operations, pulp and paper-mill plants, commercial and recreational fishing, municipal-wastewater treatment, and the large amount of maritime-shipping activities. Discharges from many of the offshore industries, especially marine transportation and the fishing industry, are discussed in Section IV.B.3.

Petrochemical-Industry Discharges: A major economic activity that occurs primarily in the Central and Western Gulf of Mexico and that generates and discharges pollutants is the petrochemical industry. Within this industry are oil and gas exploration, development, and production activities; pipeline transport; tanker movement of both imported and domestic petroleum products and crude oil; and petroleum- and petrochemical-refinery operations. These components are described elsewhere in this EIS (Section IV.A.). Of particular concern with regard to oil development operations are discharges of produced waters and drilling muds and cuttings into the coastal zone. Oil spills and leakage from pipelines increase hydrocarbon levels in the Gulf waters. Canals and navigation channels cut to support the oil industry have increased turbidity and saltwater intrusion within the coastal zone. Section IV.A. discusses both the OCS oil and gas activities and discharges and State oil development in more detail. Pollutants discharged from refining operations include high levels of BOD, total suspended solids, chemical oxygen demand, total Kjeldahl nitrogen (a measurement of total organic nitrogen and ammonia), and petroleum hydrocarbons. The petrochemical industry contributes almost one-fourth of all petroleum hydrocarbons entering Gulf of Mexico waters (USDC, NOAA, 1985). The NOAA Data Atlas identifies 90 petrochemical plants within the Gulf Coast region, primarily in the Houston/Galveston area and the Baton Rouge/New Orleans region along the Mississippi River. One of these, in Norco, Louisiana, produces over 30 million gallons of wastewater per day.

Industrial-Wastewater Discharges: Wastewater discharges include relatively large amounts of toxic chemicals, petroleum hydrocarbons, phosphorous, and nitrogen. Wastewater discharges from industrial, municipal, and other activities along the Gulf Coast were approximately 17,800 billion gallons/year in 1980. The chemical and allied-products industry discharges over 68 percent of all industrial wastewater entering the Gulf region. Coastal counties/parishes in which industrial-wastewater discharge is the greatest include Brazoria and Jefferson, Texas, and Calcasieu, Louisiana. Cooling-water discharges from power plants account for almost half the wastewater discharged from point and nonpoint sources in the Gulf. Coastal counties where cooling water are discharged in the greatest amounts from power plants include Hillsborough and Citrus, Florida, and Harris, Galveston, Chambers, and Jefferson, Texas.

Along with wastewater, industrial point sources in coastal counties also discharge large amounts of chlorinated hydrocarbons and phosphorus. NOAA estimated that in 1980 industrial sources of chlorinated hydrocarbons were approximately 33 million pounds per year and phosphorus loadings were about 36 million pounds per year (60% of the total amount of phosphorus discharged). The chemical and allied-products industry accounts for almost 60 percent of the discharges of chlorinated hydrocarbons and 45 percent of phosphorus discharges. Other industries discharging chlorinated hydrocarbons include petroleum refining, primary-metals production, and pulp and paper products. Coastal counties/parishes where direct discharges of chlorinated hydrocarbons are the greatest include Orange, Jefferson, and Brazoria, Texas, and Calcasieu, Louisiana. Coastal counties/parishes where direct discharges of PCB's are the greatest include Harris and Brazoria, Texas; St. Charles, Iberia, and St. James, Louisiana; and Hillsborough, Florida (USDC, NOAA, 1985).

Municipal-Wastewater Discharges: Municipal wastewater-treatment plants occurring along the Gulf Coast have been identified as important sources of natural organics and nutrients, pathogens, metals, and toxic organic compounds (all found in sludge produced as a by-product of treatment activities). These plants are the single largest direct point-source discharger of total Kjeldahl nitrogen and fecal coliform. Sludge disposal is a problem for many communities along the Gulf Coast. Most municipalities use landfills, but available land is becoming scarce. Sludge production was projected for the year 2000 for each Gulf county/parish by NOAA's Strategic Assessment Program. All counties/parishes are expected to have increases, with the exception of St. John the Baptist and West Baton Rouge, Louisiana, parishes. Pinellas, Florida and Harris, Texas, will have the greatest production by the year 2000 (USDC, NOAA, 1985).

Discharges from Hazardous-Waste-Disposal Facilities: The Gulf Coast also contains a large number of hazardous-waste-disposal facilities that serve as potential sites for releases of hazardous substances into the coastal waters. In 1985, NOAA mapped and identified these facilities in their strategic assessment data atlases of the Gulf Coast (USDC, NOAA, 1985). Harris County, Texas, which borders Galveston Bay, contained 210 uncontrolled and potentially hazardous-waste sites. Regulated hazardous-waste-disposal facilities include hazardous-waste landfills or land-treatment sites, surface impoundments and injection wells, and incinerators. These facilities are primarily located in the Galveston Bay and Mississippi River chemical corridor (south of Baton Rouge) areas. The NOAA identified 119 such facilities along the Mississippi River corridor.

Discharges from Land Development: Hydrologic modification operations for land development result in both point- and nonpoint-source discharges. Dredged material is a potential source of heavy metals, petroleum hydrocarbons, PCB's, and other pollutants that are concentrated in harbors and shipping channels. (See Section IV.B.4.a. for more details on dredging operations.) Disposal sites established to receive large loads of dredged materials are located near harbors and major rivers where frequent dredging is required to maintain navigable waterways. There are 37 Dredged Material Disposal Sites under USEPA interim designation in the nearshore waters of the Gulf (Section IV.B.4.a.).

Nonpoint Sources: Nonpoint-source pollution, as defined by the Clean Water Act of 1987 (Section I.B.4.i.), "is caused by diffuse sources that are not regulated as point sources and normally is associated with agricultural, silvicultural and urban runoff, runoff from construction activities, etc. . . . non-point source pollution does not result from a discharge at a specific, single location but generally results from land runoff, precipitation, atmospheric deposition, or percolation."

Urban Runoff: Stormwater runoff from urban areas results from the paving and other alterations of natural surfaces that reduce soil permeability. Untreated urban runoff is a major source of nonpoint-source pollution. Urban stormwater runoff is estimated at 20 billion liters per day along the Gulf Coast. Approximately 18 thousand metric tons of BOD and 13.6 thousand metric tons of petroleum hydrocarbons (particularly from disposed crankcase oil) enter the Gulf of Mexico from urban runoff. About 90 percent of fecal coliform loading comes from urban runoff. Other pollutants include Kjeldahl nitrogen, phosphorous, heavy metals, and chlorinated hydrocarbons. Orleans Parish, Louisiana, has the highest rate of runoff per square mile. The next highest are Pinellas County, Florida, and Harris County, Texas (USDC, NOAA, 1985).

Agricultural Activities: Agricultural activities are another important source of nonpoint-source pollution, particularly nutrient loading and toxic chemical discharges. Seven coastal counties are primarily farms: Jackson, Kleberg, Refugio, San Patricio, and Wharton, Texas, and Glades and Osceola, Florida. Texas has the greatest concentration of farms. Livestock is the dominant farming activity in all states except Alabama. Various farming activities have different effects on water quality. Livestock can cause overgrazing, which results in erosion and runoff. Agricultural runoff usually contains fertilizers and pesticides that deteriorate coastal water quality. Runoff from heavily fertilized agricultural lands usually increases the availability of nutrients and intensifies eutrophication problems. Nonurban runoff accounts for almost 50 percent of the total discharges of Kjeldahl nitrogen into coastal Gulf waters and 36 percent of the total discharge of phosphorus (90% of all nonpoint source phosphorus discharges). Coastal counties/parishes with the greatest phosphorus discharge from nonpoint sources include Nueces, Victoria, and Jackson, Texas, and Acadia, Vermilion, and Lafourche, Louisiana (USDC, NOAA, 1985)

Upland Sources: One of the major sources of contaminants to the coastal/nearshore Gulf waters is upstream waters found in the drainage of the Mississippi River/Atchafalaya River system. The Mississippi River is a major source of freshwater, with a drainage basin of almost 3,240,000 km^2 (41% of the land area of the lower 48 states) (USDC, NOAA, 1985). The Mississippi River and the Atchafalaya River, along with 20 other major river systems along the Gulf Coast (discharge rates greater than 30 m^3/s, are major sources of nutrients, heavy metals, pathogens, and organic and inorganic pollutants entering coastal and estuarine waters from upstream industrial, municipal, and agricultural sources. Tidal activity within estuaries then determines the residence time of the substances prior to their discharge into the open Gulf waters. Eighty percent of heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, and zinc) are brought to Gulf coastal areas by rivers and streams, primarily the Mississippi/Atchafalaya river system. Almost 12 times more wastewater enters the Gulf's coastal waters from upstream sources than from all (industrial, municipal, and other) coastal activities. Approximately 80 percent of all organic material, 75 percent of Kjeldahl nitrogen, and 80 percent of all phosphorus entering the Gulf is carried there by rivers and streams (USDC, NOAA, 1985).

Contaminated Areas

Understanding the geographical distribution of contaminant concentrations along the Gulf Coast provides a description of the general health of coastal water quality of the northern Gulf of Mexico. Areas identified as receiving large amounts of contaminants may not be the final receptacles for the compounds. Contaminants may be transformed biologically or chemically and broken down into new substances, or they may be mixed vertically and horizontally in the water and carried away by currents and tides.

At present, only NOAA's Status and Trends Program provides comprehensive field measurements quantifying the health of the coastal water quality of the entire Gulf Coast (USDC, NOAA, 1988b). This program has made systematic measurements of the concentrations of synthetic organics and other compounds in bivalves, bottomfish, and sediments at sites along the Gulf Coast since 1984. Sites were deliberately selected away from major point sources of contamination in order to determine where the sources (described previously) are influencing regional water quality. Sixty-four sites were sampled along the Gulf Coast, usually in embayments and behind barrier islands. Except for some sites near the Florida cities of Jacksonville, Tampa, Panama City, and Ft. Walton Beach, levels of contamination within the Gulf of Mexico coastal areas were relatively low when compared to the rest of the United States coastal areas. These four areas in Florida contained contaminants that ranked within the highest 20 concentrations found in U.S. coastal waters. Tampa Bay contained high levels of lead, polychlorinated biphenyls, chlorinated pesticides, and total organic carbon. St. Andrew Bay and Choctawhatchee Bay, Florida, contained high levels of the same compounds as Tampa Bay, as well as DDT, polyaromatic hydrocarbons, and arsenic. Mississippi Sound, near Mississippi, showed high levels of polyaromatic hydrocarbons and chlorinated pesticides. It is immediately evident that the highest levels of contamination of the Gulf Coast occur in coastal areas that are in proximity to urban development existing close to the shoreline.

B. BIOLOGICAL RESOURCES

1. Coastal Habitats

a. Coastal Barriers

Coastal barrier landforms consist of islands, spits, and beaches that stretch in an irregular chain from Florida to Texas as shown on Visuals Nos. 5 and 5E. These elongated, narrow landforms are composed of sand and other unconsolidated, predominantly coarse sediments that have been transported and deposited by waves, currents, storm surges, and winds. Barrier landforms are young coastal features. They began to form 5,000 to 6,000 years ago after the main mass of continental ice sheets had melted and the global rate of sea-level rise began to slow.

The term "barrier" identifies the structure as one that protects other features, such as bays, lagoons, estuaries, and marshes, from the direct impacts of the open ocean. By separating coastal waters from the ocean, barriers contribute to the amount of estuarine habitat available along the coast. As much as two-thirds of the high-value Atlantic and Gulf species of fish are considered to be directly dependent during some stage of their life on conditions in an estuary (Clark, 1976). Another benefit of both the barriers and their adjacent marshes and bays is that of providing habitats for a large number of birds and other animals, including several threatened or endangered species, such as the loggerhead turtle, the southern bald eagle, the alligator, and the brown pelican.

Barrier landforms are relatively low landmasses that are continually adjusting their configuration in response to changing environmental conditions. Landform changes can be seasonal and cyclical, such as the transition from a summer (swell wave) beach to a winter (storm wave) beach, or they can proceed in one direction, such as a net landward or longshore drift of a feature. The long-term survival of fixed structures, such as roads, buildings, and power lines, constructed on a barrier landform can often be jeopardized by the changing and migratory nature of the barrier features.

Some types of construction or stabilization projects on barrier landforms may actually encourage erosion, especially when the project interferes with longshore or shore-normal sediment movements. The MMS has funded a study entitled *Pipelines, Navigation Channels, and Facilities in Sensitive Coastal Habitats: An Analysis of Outer Continental Shelf Impacts, Coastal Gulf of Mexico* (Wicker et al., 1989) to examine the impacts of pipeline and navigation-canal installations on barrier islands in the Western and Central Gulf of Mexico. The results of this study indicate that these projects have not had a noticeable effect on normal coastal processes.

Coastal barriers consist of several component environments. The beach itself consists of the foreshore, the sloping part of the beach facing the ocean, and the backshore, the part of the beach from the berm crest to the dunes. The dune zone of a barrier landform can consist of a single dune ridge, several parallel dune ridges, or a number of curving dune lines that are stabilized by beach grass. In most cases, the berm grades into the dune zone, but sometimes the berm may be missing and the beach foreshore may be adjacent to the dunes. Overwash fans are located behind the dunes along barriers whose dunes are breached by storm surges. Along more stable barriers, the area behind the dunes consists of broad, vegetated flats. These flats grade into wetlands and intertidal mud flats that fringe the shore of lagoons and embayments. In other areas, barriers can be located right against the mainland with no bay or lagoon separating the two landforms.

The accumulation and movements of the sedimentary deposits that make up barriers are often described in terms of transgressive and regressive sequences. Transgressions and regressions are related to local relative sea-level change and the rate of sedimentation and erosion. A transgressive sequence is one in which the shore moves landward and marine deposits rest on terrestrial deposits. In contrast, a regressive sequence is one in which terrestrial sediments are deposited over marine sediments as the land builds out into the sea.

Transgressive barrier landforms have a predominantly low-profile morphology. These barriers are characterized by narrow widths; low, sparsely vegetated discontinuous dunes; and numerous, closely spaced active washover channels. Transgressive barriers are usually undergoing active erosion. Regressive barriers, in contrast, have high-profile morphologies including broad widths; high, continuous, and well-vegetated sand dunes; few, if any, washover channels; parallel accretion ridges; and thick accumulations of sand. Both transgressive and regressive barriers occur in the Gulf of Mexico.

A description of barrier landforms in different areas of the Gulf of Mexico follows.

Central Gulf of Mexico

The barrier landforms of the Central Gulf of Mexico occur in three settings. From east to west, these include the barrier islands of Mississippi Sound, the Mississippi River deltaic plain barriers, and the barriers of the Chenier Plain in Louisiana. The Mississippi Sound barrier islands are relatively young, having formed some three to four thousand years ago as a result of shoal-bar aggradation (Otvos, 1979). The positions of the islands have not changed significantly since that time. The islands are well vegetated by a southern maritime climax forest of pine and palmetto. The islands generally are regressive with high beach ridges and prominent sand dunes. Although overwash channels do not commonly occur, the islands may be overwashed during strong storms. The islands in general are stable, with no trend toward erosion or thinning of the island, but with a trend toward westward migration in response to the predominantly westward-moving longshore currents. An exception to this general rule is Dauphin Island, Alabama, which is essentially a low-profile transgressive barrier island, except for a small Pleistocene core at its eastern end. The western end is a Holocene spit that is characterized by small dunes and washover fans with marsh deposits and tree stumps exposed in the surf zone. The Mississippi Sound islands are separated from each other by tidal inlets with deep, wide channels. These channels have associated ebb and flood tidal deltas. Shoals are adjacent to all the barriers. The barriers are separated from the mainland by the Mississippi Sound. Most of the Mississippi Sound barrier islands are included in the Gulf Islands National Seashore.

Louisiana has the most rapidly retreating beaches in the nation. The average retreat rate for Fourchon Beach over the past 100 years has been in excess of 18 m/yr. The statewide average exceeds 3.6 m/yr (Dolan et al., 1982). Beaches along the deltaic plain in Louisiana fit into one of three categories, depending on the stage of the deltaic cycle that the nearby landmass is experiencing. When a major distributary of the Mississippi River is abandoned, subsidence results in a local sea-level transgression that transforms the active delta into an erosional headland with flanking barriers. Fourchon Beach is an example of an eroding headland beach. With increased age and subsidence, the barrier shoreline evolves into a transgressive barrier-island arc that is separated from the mainland by a lagoon. Isles Derniers is an example of a barrier that underwent the transformation from a headland beach to a barrier arc within the past century. Eventually, with continued subsidence and sediment deprivation, the island ceases to exist, its remnant forming a submarine inner-shelf shoal (Penland and Boyd, 1985).

The Chenier Plain is located farther to the west in Louisiana. Here, the coast is fronted by sand beaches and coastal mudflats. The source of the mud is the discharge of the Mississippi and Atchafalaya Rivers, which tends to drift westward along with the prevailing winds and associated nearshore currents. Fluid mud extends from the seaward edge of the marsh grasses to a few hundred yards offshore. The mud is an extremely effective wave-energy absorber. Consequently, the mainland shore is rarely exposed to effective wave action except during storms. The sand beaches that occur along the Chenier Plain rest against the mainland marshes. Although the beaches consist of only a thin accumulation of sand and although some parts of the coast are experiencing erosion, on the average, the Chenier beaches are regressive.

Western Gulf of Mexico

From the Texas-Louisiana border to Rollover Pass, Texas, the Texas coast is a physiographic continuation of the Chenier Plain. In contrast to the Louisiana Chenier Plain, however, the Texas Strandplain is essentially transgressive. Here, thin accumulations of sand, shell, and caliche nodules make up beaches that are migrating landward over tidal marshes. These beaches are narrow and have numerous overwash features and local, poorly developed sand dunes.

The rest of the Texas coast is a continuous barrier shoreline. The barrier islands and spits were formed from sediments supplied from three deltaic headlands: the Trinity delta in Jefferson County immediately west of the Sabine River; the Brazos-Colorado Rivers delta complex in Brazoria and Matagorda Counties; and the Rio Grande delta in southernmost Cameron County.

The Texas barriers are arranged symmetrically around these erosional deltaic headlands. Erosional and accretionary barriers are about evenly split. Erosional barriers have developed along the deltaic headlands and tend to be narrow, sparsely vegetated, and have a low profile and numerous washover channels. Accretionary (regressive) barriers occur on either side of retreating deltaic headlands and tend to be wide; to have prominent vegetated dunes; and to contain few, if any, washover channels. Accretionary barriers grade into erosional barriers within interdeltaic embayments.

Climate is an important variable that affects the Texas coast. Texas is the only Atlantic or Gulf State with a significant climate range. The climate changes from humid-subtropical in the east to semiarid in the south. South of Corpus Christi, the annual evaporation exceeds the precipitation, and the landscape has an arid appearance. On high-profile, southern barriers, vegetation is sparse; and nearly continuous winds have built high dunes.

Eastern Gulf of Mexico

Along the panhandle coast of Florida to Cape San Blas, the barrier islands and beaches fringing the coast are characteristically regressive features with broad, high-profile beaches backed by dunes that are 3-4.5 m high. To the south and east of the Destin area, the beaches tend to become narrower. Washover channels and fans occur locally and are generally the result of tropical storm impacts. Many of the beaches along the coast are backed by a series of beach ridges, with each ridge truncating the previous one. These ridges indicate that in the past the coastline experienced alternating periods of erosion and deposition and changes in predominant littoral-current directions.

The predominantly east-west trend of the barrier features along the panhandle coast terminates in the Cape San Blas area. Cape San Blas is the most prominent cuspate foreland in the Gulf of Mexico. Barrier islands and spits extend for as much as 50 km on either side of the Cape. The Cape and its associated islands have been accretionary or stable during the past several decades. Beyond Cape San Blas to just north of Tampa Bay, the Florida coast takes on a concave-inward arcuate trend that is devoid of barrier features.

Barrier features appear again just north of Tampa Bay and continue to Cape Romano, located just north of the Everglades National Park. The barriers along this stretch of the Florida coast occur in three successive barrier sequences consisting of eroding headlands, flanking spits, and adjacent barrier islands. The spit and island features are symmetrically distributed on either side of the eroding headland. Most of the barriers in southwest Florida are short, narrow, and of low topographic profile. In spite of this low profile, they do not have many washover features because of the low-wave-energy conditions that prevail here.

Even though the area south of Cape Romano is located outside the Eastern Planning lease sale area, it could be affected by activities associated with the proposed sale. Although no true barrier landforms occur here, the Florida Keys, consisting of linear, cemented limestone islands, provide habitats for unique local flora and fauna and for the quiet-water environment of Florida Bay. Functionally, therefore, they are acting as barriers.

b. Wetlands

As depicted on Visuals Nos. 5 and 5E, wetland habitat types that occur along the Gulf Coast include mangroves, nonforested wetlands (fresh, brackish, and saline marshes), sandy beaches, and forested wetlands (bottomland hardwoods, cypress-tupelogum swamps, and tropical hardwood hummocks). Marshes and mangroves form an interface between marine and terrestrial habitats, while forested wetlands occur inland from marsh areas. Wetland habitats may occupy narrow bands or vast expanses and can consist of sharply delineated zones of different species, monotonous stands of a single species, or mixed-plant-species communities.

The importance of coastal wetlands to the coastal environment has been well documented. Coastal wetlands are characterized by high organic productivity, high detritus production, and efficient nutrient recycling. Wetlands provide habitat for a great number and wide diversity of invertebrates, fish, reptiles, birds, and mammals. Wetlands are particularly important as nursery grounds for juvenile forms of many important fish species. The Louisiana coastal wetlands support over two-thirds of the Mississippi Flyway wintering waterfowl population (including 20%-25% of North America's puddle duck population) and the largest fur harvest in North America (from 40% to 65% of the nation's total per year) (Olds, 1984).

Central Gulf of Mexico

Louisiana contains most of the Gulf coastal wetlands. These wetlands occur in two physiographic settings--the Mississippi River Deltaic Plain and the Chenier Plain. The present wetlands on the deltaic plain formed on top of a series of overlapping riverine deltas that have extended onto the continental shelf during the past 6,000 or so years. These wetlands are established on a substrate of alluvial and organic-rich sediment that is subject to high, natural-subsidence rates. The effects of subsidence are compounded by sea-level rise, which has been occurring during the past several millenia. Under natural conditions, sedimentation encourages vertical accretion of wetland areas and may offset the submergence and inundation that result from subsidence and sea-level rise. Areas of the deltaic plain that are located near an active channel of the Mississippi River tend to build outward, and marsh areas tend to expand. At the same time, areas located near inactive, abandoned channels tend to deteriorate and erode as a result of the lack of sediment.

The Chenier Plain, located to the west of the Atchafalaya Bay in the western part of coastal Louisiana, is a series of separate ridges of shell and sand, oriented parallel or oblique to the coast, that are separated by progradational mudflats that are now marshes or open water. The mudflats are built during times when the Mississippi River channel is located on the western side of the deltaic plain or when minor changes in localized hydrologic and sedimentation patterns favor deposition in the Chenier area.

The deterioration of coastal wetlands, particularly in Louisiana, is an issue of concern. In Louisiana, the annual rate of wetlands loss has been measured at 130 km^2 for the period 1955-1978. Several factors contribute to wetlands loss in coastal Louisiana, including sediment deprivation (a result of a 50% decrease in the suspended-sediment load of the river since the 1950's and the channelization of the river, which has prevented overbank sediment deposition), subsidence and sea-level rise, and the construction of pipeline and navigation canals through the wetlands.

A recent study funded by MMS entitled *Causes of Wetland Loss in the Coastal Central Gulf of Mexico* (Turner and Cahoon, 1987) investigated how wetland habitats have changed in the northern Gulf of Mexico as a result of natural processes and human activities. The study's primary focus was on assessing and quantifying the direct and indirect impacts of OCS-related activities on wetland areas since the 1950's. Canal construction for pipelines and navigation has been the major OCS-related impacting factor.

Direct impacts were defined as those physical alterations that are the direct result of canal construction. Direct impacts include wetlands alterations that result from the actual dredging of the canal, the disposal of dredge spoil, and any subsequent widening of the canal as a result of channel-bank erosion. Based on the study's findings, OCS-related direct impacts have accounted for 16 percent of all the direct impacts that have occurred in Louisiana's wetlands (12,000 ha out of 74,000 ha). Direct OCS impacts account for only 4-5 percent of the total wetlands loss during the period 1955/56 to 1978. The average areal impact per kilometer of constructed pipeline was estimated at 2.5 ha. In recent years, more stringent construction regulations have required that pipelines installed across wetlands be backfilled with spoil material immediately after the pipeline is emplaced in its ditch. The study showed that the backfilling of pipeline canals reduced direct impacts to 0.7-1.0 ha/km. Direct impacts per unit length of OCS-related navigation canals are about 20 times greater than OCS pipeline canals.

Indirect impacts are those that occur as a result of hydrologic changes (salinity and drainage regimes) brought on by canal construction. Indirect impacts can be propagated away from the immediate area of the canal impact (as a result of the backwater effects of the hydrologic alterations), and they can occur over long time periods. Indirect impacts interact with the other factors that contribute to wetlands loss (sediment deprivation and submergence) in such complex and synergistic ways that it will be difficult to quantify their magnitude with great precision. The MMS-funded study (Turner and Cahoon, 1987) concluded that the indirect impacts of OCS activities account for 4-13 percent of all indirect impacts and that indirect impacts account for 20-60 percent of the total amount of wetlands loss. The report cautions, however, that these numbers are based on the interpretation of limited data and should be used with caution to indicate only the relative magnitudes of possible impacts.

In Mississippi and Alabama, the mainland marshes behind Mississippi Sound occur as discontinuous wetlands associated with estuarine environments. The most extensive wetland areas in Mississippi occur east of the Pearl River delta near the western border of the State and in the Pascagoula River delta area near the eastern border of the State. The wetlands of Mississippi are more stable than those in Louisiana, reflecting the more stable substrate and more active sedimentation per unit of wetland area. Also, there have been only minor amounts of canal dredging in the Mississippi wetlands. Wicker et al. (1989) have studied the impacts of three pipeline canals in the Mississippi wetlands near the Pearl River delta. One of the pipelines was backfilled after construction. No noticeable geologic or botanic impacts were observed along the pipeline route. The two other pipelines were installed with the open-ditch dredging method and the canals had not been backfilled. The open ditches did not revegetate and had in fact widened over time as a result of channel-bank erosion. No indirect impacts, however, were observed in the marshes away from the canals as is frequently seen in Louisiana.

Most of the wetlands in Alabama occur on the Mobile River delta or along northern Mississippi Sound. Between 1955 and 1979, fresh marshes and estuarine marshes declined by 69 percent and 29 percent, respectively, in these areas. On a percentage basis, wetlands loss has occurred more rapidly in Alabama during these years than it did in Louisiana. Major causes of nonfresh wetland losses were industrial development-navigation, residential-commercial development, natural succession, and erosion-subsidence. Loss of fresh marsh was mainly attributable to commercial-residential development and silviculture (Roach et al., 1987).

Western Gulf of Mexico

In Texas, coastal marshes occur along the inshore side of barrier islands and bays and on river deltas. Salt marshes consisting primarily of smooth cordgrass occur at lower elevations and at higher salinities. Brackish marshes occur in transition areas landward of salt marshes on slightly higher elevations and at greater distances from saltwater bodies. Freshwater marshes of the region occur primarily along the major rivers and tributaries. Sparse bands of black mangroves are also found in this region. Broad expanses of emergent wetland vegetation do not commonly occur south of Baffin Bay at the northern edge of Kenedy County because of the arid climate and hypersaline waters to the south. In these areas, *Spartina alterniflora*, the most common salt-marsh grass elsewhere in the Gulf, occurs rarely in salt marshes. Common salt-marsh plants here include more salt-tolerant species such as *Batis maritima* and *Salicornia* (White et al., 1986).

Wetland changes that have been observed in Texas during the past several decades appear to be driven by subsidence and sea-level increases. Open-water areas are appearing in wetlands along their seaward margins, while new wetlands are encroaching onto previously nonwetland habitat along the landward margin of wetland areas on the mainland, on the back side of barrier islands, and onto spoil banks. In addition, wetlands are being affected by human activities including canal dredging, impoundments, and accelerated subsidence caused by fluid withdrawals. The magnitudes of these wetland acreage changes in most of Texas have not been determined at the present time. In the Freeport, Texas, area along the Louisiana border, wetlands loss is occurring at rates similar to those that occur in adjacent parts of the Louisiana Chenier Plain. In the Sabine Basin area of coastal Texas, for example, 20,548 ha wetlands were lost between 1952 and 1974 (Gosselink et al., 1979).

Eastern Gulf of Mexico

Coastal marsh habitat in Florida occurs for the most part north of Tampa Bay. To the south, because of milder winter temperatures, mangrove swamp predominates. In the northern part of the state, emergent wetlands have very little distribution in the Florida panhandle. The limited areas of wetlands that do occur occupy narrow, often discontinuous bands in saline and brackish zones behind barrier islands and spits, near river mouths, and along some embayments. The most extensive and continuous expanse of coastal marshland in the EPA occurs along the Big Bend coastline between Cape San Blas and Pasco County, just north of Tampa Bay. These wetlands are dominated by needle rush. This stretch of the coast is exposed to very low wave energy because of the broad and very shallow offshore bank. This low-energy environment allows the marsh edge to grow out directly into Gulf waters.

About 189,945 ha of mangroves are estimated to occur within Florida. About 90 percent of Florida's mangrove area occurs along the Gulf Coast from the Caloosahatchee River to the southernmost part of the peninsula. Mangrove ecosystems function much like coastal marshes, providing shoreline stabilization, and storm protection, habitat for wildlife and fisheries and enhancing aesthetic and economic values.

Destruction of mangrove forests in Florida has occurred in various ways including outright destruction and land filling, diking, and pollution damage. Any process, natural or man-induced, that coats the aerial roots with fine sediments or covers them with water for extended periods has the potential for mangrove destruction (Odum et al., 1982).

c. Seagrasses

There are an estimated 3 million ha of submerged seagrass beds in the exposed, shallow coastal waters of the northern Gulf of Mexico. An additional 166,000 ha confined to the natural embayments are considered unexposed and not dealt with in detail for this report. The area off Florida contains the vast majority of such beds, containing approximately 98.5 percent of all coastal seagrasses in the northern Gulf of Mexico. Coastal seagrass beds in Texas and Louisiana comprise approximately 0.5 percent of the exposed seagrasses, with Mississippi and Alabama the remaining 1 percent of the habitat. A combination of low salinity and high turbidity accounts for the narrow bands and scattered patches of seagrasses occurring between Louisiana and Laguna Madre, Texas. Percentages listed above are derived in part from acreage estimates on Visual No. 14, published in concert with the Final Regional EIS (USDI, MMS, 1983) and the two reports of Continental Shelf Associates, Inc. (CSA) and Martel Laboratories, Inc. (1985) and CSA.

Subaqueous spermatophytes, commonly called seagrasses, have many important ecological functions and are an important component of the coastal ecosystem. Seagrass beds provide sediment stabilization by increasing sedimentation of suspended sediments, which also serves to provide clearer water over the top of the beds. They provide nursery habitat and shelter for the young of commercially and recreationally important species of fish and shellfish; and they attract a diverse and prolific epiphytic biota, serving as sites of attachment for many mollusks and often creating unique habitat for the existence of certain species. Seagrasses contribute oxygen and nutrients to the water column and serve as both direct and indirect food sources for many marine species. Seagrass meadows provide a region of high production and growth that offers sustenance, high detrital input to the coastal ecosystem, habitat diversity and stability, and refuge for the associated organisms. Seagrasses also function mechanically by dampening wave energy and increasing sedimentation rates, thereby purifying coastal waters. The beds grow in shallow, relatively clear and protected waters with predominantly sand bottoms. Their distribution depends on an interrelationship among a number of environmental factors that include temperature, water depth, turbidity, salinity, and substrate suitability. In general, luxuriant growth of seagrasses and the concomitant high diversity of associated marine species are found within a band that roughly parallels the coastline in waters less than 20 m deep in the Eastern Gulf and in the more protected waters of the northern and western Gulf of Mexico.

Many studies have been completed to document the ecological importance of seagrass meadows and the roles they serve in coastal ecosystems. A few of the more comprehensive and/or regional works include those of Zieman (1982), Thayer et al. (1984), Lewis et al. (1985), Iverson and Bittaker (1986), Stevenson (1988), Durako (1988), and Kenworthy et al. (1988).

While most of the seagrass species reproduce most rapidly through vegetative reproduction, they also produce seeds under optimal conditions. The various species of seagrasses support widely different levels of biomass production. Biomass represents the amount of plant material present in a measured area at a given time and may be considered an indicator of the growth and production levels of a species. Turtle grass (*Thalassia testudinum*) is the largest of the common species, is most commonly found forming dense beds at water depths of less than 10 m, and may possess a rhizome buried up to 25 cm below the seafloor. In terms of biomass production, turtle grass is one of the most prolific of the seagrass species, with average biomass values of 500-3,100 g/m^2, and extremes up to 8,100 g/m^2 (values summarized from Zieman, 1982). Manatee grass (*Syringodium filiforme*) possesses very long, thin leaves, with vegetative reproduction from the shallowly buried rhizome, which is less massive than that found in turtle grass. Biomass values average 100-300 g/m^2, with extremes up to 1,100 g/m^2. Shoal grass (*Halodule wrightii*) may be considered a "pioneer species" in that it is important in colonizing disturbed areas and deeper water areas beyond the ranges of the more coastal species. Biomass values average 50-250 g/m^2 with extremes of up to 1,000 g/m^2 (CSA, 1989). *Halophila* species reproduce vegetatively through rhizomes, which may often be exposed. It is found in water depths to 37 m on the southwest Florida shelf, with greatest concentrations at shallower depths. Precise values regarding production of biomass of the *Halophila* species is difficult to acquire. However, Zieman (1982, page 20; 1989, page 34) has noted that the biomass of *Halophila* is always low. Philipps and Thompson (1989) have noted the biomass of *Halophila* is "hundreds to thousands of times lower" than the nearshore seagrass beds. They reported dry-weight biomass values of 0.002 to 1 g/m^2 for *Halophila*. Comparable values of dry-weight values for the other dominant species range from 50 to 3,100 g/m^2.

Seagrasses dominate the aquatic flora habitat in the estuarine communities along the Texas coast. Dominant species include shoal grass *(Halodule wrightii)*, widgeongrass *(Ruppia maritima)*, turtle grass *(Thalassia testudinum)*, and manatee grass *(Syringodium filiforme)*. The first two species listed are in greatest abundance due to their ability to sustain salinity variations that occur in a number of the lagoon and bay systems of Texas. The Laguna Madre and Copano-Aransas estuaries account for the major portion of the seagrass populations. Seagrasses are less common in Corpus Christi Bay because of the Bay's greater water depth. These seagrasses provide an important habitat for immature shrimp, black drum, spotted seatrout, juvenile southern flounder, and several other fish species; and they provide a food source for several species of wintering waterfowl. There are seven areas in Louisiana coastal waters where habitat conditions are favorable for the establishment of submergent marine grasses. The turbid waters and soft sediments of Louisiana's estuaries limit more widespread distribution. These areas include the bay side of Isle Dernieres, Timbalier and East Timbalier Islands; along the north shore of Lake Pelto, Old Lady Lake, and the southeastern shore of Timbalier Bay; the western side of the Chandeleur Islands; the southwestern corner of Lake Salvador in

Temple and Catahoula Bays; and, farther north, scattered patches in Lakes Catherine, Pontchartrain, and Maurepas. Species most commonly found include turtle grass (*Thalassia testudinum*), shoal grass (*Halodule wrightii*), Gulf *Halophila* (*Halophila engelmanni*), and manatee grass (*Syringodium filiforme*) (Burk and Associates, Inc., 1977).

Seagrass communities of the west Florida shelf are variable in species composition, with six dominant species found at different locations, depending on environmental conditions. CSA (1989) has documented 1,011,403 ha of seagrass distributed in waters shallower than 20 m in the Big Bend area of West Florida and 1,887,784 ha in water depths to 37 m in Florida Bay and adjacent waters. Additional exposed seagrass areas may be found off other coastal regions; however, the absolute amount of seafloor covered varies annually and can never be precisely known.

Six species of seagrass are most commonly encountered in the shallow waters of West Florida. Turtle grass (*Thalassia testudinum*) is the largest of the common species, with ribbon-like leaves up to 12 mm across and 35 cm in length. This species may form very large, dense beds or meadows, which persist from year to year. It is most commonly found forming dense beds at shallow water depths (i.e., 1-10 m), with the lower limit of the lush seagrass distribution represented as a function of the water clarity and sediment suitability; it is very seldom deeper than 15 m. Manatee grass (*Syringodium filiforme*) has very long, thin leaves, 1.0-1.5 mm across and up to 50 cm in length. This species rarely forms extensive monospecific beds and is more likely to be found mixed with other seagrasses or in very small patches. It is most commonly found in water depths of 1-20 m. Lower depth limits are dependent on light penetration through the water column and sediment suitability. Shoal grass (*Halodule wrightii*) may be considered a "pioneer species" in that it is important in colonizing disturbed areas and is tolerant of broad environmental conditions. Because of this tolerance, shoal grass often may be found in areas that may not be used by either of the species listed above. Three Halophila species are broadly distributed over the study area. These seagrasses are generally smaller and less productive than the three species discussed previously. One of the Halophila species has been recorded from waters depths of 37 m in the waters of the southwest Florida shelf, with peak blade densities at the 20-27-m-depth range.

Seagrasses generally have periods of vigorous growth during the summer months, while severely restricted growth or die-offs are documented during the winter months. The various seagrass species have possess distinct tolerance levels to periods of exposure and resistance to storm events. Cyclical events, such as a mild or severe winter, will greatly affect the amount of seagrass directly killed due to thermal stress (Zieman, 1982). Conversely, as discussed below, aperiodic tropical storms or hurricanes will mechanically disrupt enormous portions of the seagrass community on the shelf region during peak growing conditions.

Natural phenomena can have extreme detrimental effects on the seagrasses of the west Florida shelf, yet some may be resilient to the trauma that may occur. Continental Shelf Associates (1987) documented the effects of a hurricane that passed through the Florida Big Bend area in 1985. The complete denuding of approximately 116,640 ha of offshore seagrass habitat (*Halophila*) by the storms of 1985/1986 was documented for an area that previously had been a biological monitoring site for which a fair description of the seagrass distribution existed. The tropical storms passed through the region during the summer months of 1985, and it was documented that their passage uprooted large sections of the seagrass communities and the associated sessile invertebrates. Large amounts of organic debris were found on the seafloor and within the water column. Only one month later, no debris was found, and the areas had recovered to pre-hurricane conditions within a single growing season. The report's conclusions are that the west Florida shelf communities are very resilient to these traumatic types of perturbations and that many of the species are rapid recolonizers.

A second phenomenon that is currently affecting the seagrasses of South Florida is the *Thalassia* die-off. This condition, to date, has severely affected 6,075 ha of shallow-water *Thalassia* beds of Florida Bay and an additional 18,225 ha to a lesser extent (Robblee, personal comm., 1989). Whether the cause of the die-off is anthropogenic or natural is not known at this point, but several theories appear to have merit. Poor water-management strategies, abnormal meteorological conditions, and naturally occurring pathogens have all been suggested as the sources of the problem. The reason for the die-off will probably be shown to be a combination of a number of factors causing unusual stress and increasing the susceptability of the seagrasses to natural agents. Whatever the cause, the die-off may well lower the abundance and regional distribution patterns of seagrasses in southern Florida. However, there is already some evidence that other seagrasses are colonizing the regions denuded by the *Thalassia* die-off.

2. Offshore Habitats

The term "offshore habitats" refers to the water column and the seafloor. Seafloor (benthic) habitats are the most likely to be adversely affected by offshore oil and gas operations, especially live-bottom areas, deep-water benthic communities, and topographic features; these habitats are treated in some detail in Sections III.B.2.a., b., and c. below.

Water-column biota include the plankton and nekton. In general, the diversity of planktonic species decreases with decreased salinity, and biomass decreases with distance from shore.

Nekton are dominated by five major taxonomic categories--marine mammals, reptiles, fishes, cephalopod mollusks, and crustaceans. Individuals may range over broad areas; however, most nekton are limited to geographical and vertical ranges by the same environmental conditions as less motile organisms, that is, temperature, salinity, and available food. Most of the fishes of the Gulf shelf habitats are temperate, with incursions of Caribbean faunas; they exhibit seasonal distribution and abundance fluctuations that are probably largely related to oceanographic conditions.

Generalizations regarding water-column habitats are difficult to make because of the patchy nature of biotic distributions, which tend to congregate in patches of various sizes that move with the prevailing winds and currents. Endangered and threatened species are described in Section III.B.3. below, marine mammals in Section III.B.4., birds in Section III.B.5., and fishes and fisheries in Sections III.B.6., and III.C.3. and 4.

Benthic communities of the continental shelf and slope are discussed in general terms before treating the three specific offshore habitats most likely to be impacted by the leasing proposals.

Continental Shelf

The benthos has both floral and faunal components, the floral representatives being algae and seagrasses. The abundance of benthic algae is limited by the scarcity of suitable substrates and light penetration. Rezak et al. (1983) recorded algae from submarine banks off Louisiana and Texas. In exceptionally clear waters, benthic algae, especially coralline red algae, are known to grow in water depths to at least 183 m. Offshore seagrasses are not conspicuous in the Central and Western Gulf; however, fairly extensive beds may be found in estuarine areas behind the barrier islands throughout the Gulf as discussed in Section III.B.1.c. Seagrasses would be continuous around the entire periphery of the Gulf if it were not for the adverse effects of turbidity and low salinity of the Mississippi River effluent from the delta to Galveston (Humm, 1973).

Benthic fauna include the infauna (animals that live in the substrate, such as burrowing worms and mollusks) and epifauna (animals that live on the substrate, such as mollusks, crustaceans, hydroids, sponges, and echinoderms). Shrimp and demersal fish are closely associated with the benthic community. Substrate is the single most important factor in the distribution of benthic fauna (Defenbaugh, 1976), although temperature and salinity are also important in determining the extent of faunal distribution. Other lesser important factors include illumination, exposure to air, nutrient availability, currents, tides, and wave shock. Defenbaugh (1976) states that depth and/or distance from shore should also be considered as major influences on the benthic faunal distribution.

In general, the vast majority of the benthos of the Central and Western Gulf consists of soft, muddy bottoms dominated by polychaetes. Benthic habitats that are at the most risk to potential impacts from oil and gas operations are those of the topographic features, discussed in Section III.B.2.c. below, and the pinnacle trend live bottom, discussed in Section III.B.2.a. below. The dominant bottom conditions in the Eastern Gulf consist of the low-relief live bottoms discussed in Section III.B.2.a. below. Seagrass beds, particularly important in the Eastern Gulf, are discussed in Section III.B.1.c. above.

The Florida Middle Ground is probably the best known and most biologically developed of the Eastern Gulf live bottoms, with extensive inhabitation by hermatypic (reef building) corals and related communities. This area is 160 km (87 nmi) west-northwest of Tampa and has been designated as a Habitat Area of Particular Concern (HAPC) by the Gulf of Mexico Fishery Management Council (50 CFR 638). Within the HAPC, bottom longlines, traps and pots, and bottom trawls are prohibited. The taking of any coral is prohibited except as authorized by permit from the National Marine Fisheries Service (NMFS).

The Florida Middle Ground represents the northernmost extent of coral reefs and their associated assemblages in the Eastern Gulf (Bright and Jaap, 1976; Rezak and Bright, 1981). The Middle Ground is similar to the Flower Garden Banks off Texas--typical Caribbean reefal communities--although both are depauperate in terms of the number of species present, probably because it is considered to be at the northern limit of viable existence for these types of coral communities (Bright, personal comm., 1975; Hopkins et al., 1977). Coral reef communities are exceedingly complex and have been treated at length by Bright and Jaap (1976) and Faulkner and Chesher (1979). It is sufficient to state that, in general, hermatypic corals require temperatures of 18°C-30°C, with the optimum at about 26 ° C; salinities from 36-40 ppt (parts per thousand), with the optimum at 36 ppt; little pollution and nutrient load; and adequate light (i.e., little turbidity). In the Caribbean they may grow as deep as 80 m, while in the Gulf they seem to be limited to a depth of about 40 m (Bright and Jaap, 1976). The Middle Ground reefs rise essentially from a depth of 35 m, and the shallowest portions are about 25 m deep. Significantly productive areas comprise about 12,126 ha (29,943 ac).

The Florida Middle Ground supports numerous Caribbean fish, corals, and invertebrates. This is probably due to the intrusion of the Loop Current, short periods of low temperatures, and high organic productivity. A total of 197 species of fish, with largely tropical West Indian affinity, have been reported at the Middle Ground (Rezak and Bright, 1981). The benthos of the Florida Middle Ground is composed of hard and soft corals, sponges, and algae. The hard corals include *Madracis decactis*, *Porites divaricata*, *Dichocoenia stellaris*, and *Dichocoenia stokesii*. Octocorals, relatively minor components of other Gulf reefs, are prominent at the Middle Ground. Dominant octocorals include *Muricea elongata*, *M. laxa*, *Eunicea calyculata*, and *Plexaura flexuosa*. The biota of the Middle Ground is sensitive to environmental change, as documented by Rezak and Bright (1981).

The 23 lease blocks containing the Florida Middle Ground area are not included in this proposal.

Although not in the planning area for these proposed sales, the Florida Keys comprise an important shallow-water, tropical, coral-reef ecosystem that is unique on the continental shelf of North America. Coral reefs are closely interrelated and interdependent with other marine and terrestrial communities that compose the coastal ecosystem. Energy, chemical constituents, and mobile species move between the reefs and other communities, including mangrove, seagrass, sedimentary, and hardground communities. In addition, the coral reefs of the Keys are important to the economy of Florida. Commercial and recreational fishing, as well as such nonconsumptive uses as boating, scuba diving, snorkeling, and educational and natural history activities are big businesses (Jaap and Hallock, in press).

Jaap and Hallock (in press) have recently reviewed the Florida Keys ecosystem. The following is taken from their work:

> Coral reefs are characterized by high species diversity; rapid recycling of nitrogen and phosphorus nutrients; high gross primary productivity and low net primary productivity; highly transparent water; many species with specialized food requirements, narrow niches, and complex life cycles; symbiotic relationships; and primary productivity by microscopic symbiotic algae (zooxanthellae) within the reef corals.
>
> The Florida reef tract is the only shallow-water tropical coral reef ecosystem found on the continental shelf of North America. The Florida Keys archipelago, extending from Soldier Key to the Dry Tortugas, exhibits a diverse array of hardgrounds, patch reefs, and bank reefs from 25 m to 13 km offshore. To the west and north of the Keys lie a series of shallow embayments and the continental shelf off southwest Florida. To the east and south are the Straits of Florida with the Florida Current, which is crucial to the reefs: moderate winter temperatures and warm, clear, relatively nutrient-poor waters permit the slow-growing, reef-building corals to compete successfully with faster-growing live-bottom biota. Coral reef distribution patterns reflect the extent of water exchange between the continental shelf and the Atlantic. Heavy rainfall, drought, summer doldrums, and winter cold fronts influence temperature, salinity, nutrient supply, and turbidity in the shallow bays and sounds, producing water quality generally unfavorable to reef development. Large islands act as barriers to offshelf transport from Florida Bay and Biscayne Bay, thus Key Largo and Elliott

Key have extensive offshore reefs. The middle Keys, which are smaller and separated by numerous wide channels communicating with Florida Bay, have limited reef development. The island mass from Big Pine Key to Key West also provides a barrier to water transport, and thereby allows extensive reef development off this area.

Coral reefs are three-dimensional limestone frameworks produced by the skeletons of coral and coralline algae. Upward growth of a reef occurs because organisms living on the reef secrete calcium carbonate as part of their growth process. Lime sands and muds, produced by biological and physical breakdown of shells and skeletons of invertebrates and calcareous algae, also contribute to the reef mass by collecting in voids within the reef framework and are then cemented into the reef by encrusting coralline algae and by geochemical processes. While growth processes are building the reef, destructive forces are acting to erode the structure. Physical agents include dissolution waves, especially those of storms and hurricanes. Biological agents include fungi, boring sponges, marine worms, and mollusks.

The biological richness of a coral reef is remarkable (Faulkner and Chesher, 1979). Literally thousands of species are known from the Florida reef tract.

Patch reefs are the principal reef form between Elliott Key and Key Largo, where approximately 5,000 patch reefs are found. Patch reefs typically occur in water depths of about 2 to 9 m and are usually roughly circular in outline and range from 30 to 700 m in diameter. The region directly adjacent to the reef is usually barren as a result of grazing by reef-dwelling herbivores that venture from the reef to crop the algae and seagrass.

Bank reefs occur 7.4 to 13 km seaward of the Keys, paralleling the coast. Most occur off Key Largo and from Big Pine Key to Key West where major islands protect the reefs from the detrimental influence of Florida Bay waters. A reef flat is located on the inshore side of band reefs. This relatively barren area is characterized by coral rubble encrusted by coralline algae and mustard hill coral (*Porites astreoides*). Waves, intensive solar radiation, and often tidal exposure severely limit the reef-flat community. Shoreward, the reef-flat grades into a mosaic of sedimentary or seagrass habitats. Spur and groove formations are a major attribute of band reefs. Spurs are elongate reefal limestone formations covered with living corals. Grooves are valleys containing carbonate sand and rubble that separate the spurs. Spur formations are for the most part aligned perpendicular to the coast and continental shelf margin, facing into predominate wind-sea direction. The major spur builder is elkhorn coral (*Acropora palmata*). Other corals, algae, and limestone debris fill spaces between elkhorn colonies. While elkhorn dominates in shallow areas, *Agaricia agaricites* is abundant on vertical surfaces, and below 6 m large haystack colonies of *Montastraea annularis* are major contributors. The deepest portions of Florida bank reefs are in 37-40 m depths and occur as isolated outcrops surrounded by sediments.

The Dry Tortugas is composed of islands, shoals, and reefs located about 117 km west of Key West. Massive thickets of staghorn coral (*Acropora cervicornis*) occur west and north of Loggerhead Key. In a remote area to the west and north of the Dry Tortugas in depths of 64 to 76 m, a zone of highly irregular relief supports an unusual biological assemblage visually dominated by a frondose green algae and large plates of lettuce coral (*Agaricia* spp.).

In addition to their ecological, recreational, and commercial importance, the Keys have a certain intrinsic value aesthetically. This value, while difficult to quantify, is certainly significant. This value is partly recognized by the establishment of two National Marine Sanctuaries and the study of two more potential sites. Looe Key and Key Largo are popular recreational sites with active educational programs. The Sombrero Key and Alligator Reef areas are being studied as to the appropriateness of including them in the Marine Sanctuary system. These, along with the potential designation of the Flower Garden Banks as a Marine Sanctuary, demonstrate the commitment of the nation to preserve the important and relatively rare coral reef ecosystems.

Continental Slope and Deep Sea

The deep-sea area of the northern Gulf of Mexico is much less known than the shelf. Pequegnat (1983) reported observations based on 264 oceanographic stations between 150 and 3,850 m in an area including the DeSoto and Alaminos Canyons, the Mississippi Trough and Fan, and the Sigsbee Abyssal Plain. There are some remarkable biotal differences in the deep ecosystem of the Gulf. In fact, the biotal differences justify referring to the Western Gulf (corresponds to WPA and CPA) as the "true" Gulf and the Eastern Gulf (corresponds to EPA) as a divergence of the Atlantic Ocean via the Caribbean Sea (Pequegnat, 1983; LGL Ecological Research Associates, Inc. and Texas A&M University, 1986).

The highest values of surface primary production are found in the upwelling area north of the Yucatan Channel and in the region around surface DeSoto Canyon. In the oceanic region, the Western Gulf is, in general, more productive than the Eastern Gulf. It is generally assumed that perhaps except for brief periods during major plankton blooms, the zooplankton consume all the phytoplankton produced. In turn, they excrete a high percentage of their food intake as feces that sink to the bottom. Most of the herbivorous zooplankters are copepods, with calanoids the dominant group (Pequegnat, 1983).

The topographic and physical oceanographic conditions present at the East Breaks in the Western Gulf are such that a nutrient-rich upwelling could be expected in the vicinity. The NMFS has reported that the area is an important recreational billfishing area. The upwelling may contribute to this fishery.

Beneath the euphotic zone and extending to within a meter or so of the bottom is a huge mass of water that beyond the shelf is largely devoid of sunlight. This is the aphotic zone where photosynthesis cannot occur and where the processes of food consumption, biological decomposition, and nutrient regeneration take place in the cold and dark waters. The lowermost layer is the bottom itself together with the contiguous water a meter or so in thickness. This is the benthic zone, repository of sediments from above, where nutrient storage and regeneration take place in association with the solid and semisolid substrate (Pequegnat, 1983).

The slope is a transitional environment influenced by processes on the shelf and the abyssal Gulf. This transition applies both to the pelagic and the benthic realm. The general conclusions that may be reached are as follows: (a) the shelf phyto- and zooplankton are more abundant, more productive, and seasonally more variable than the deep Gulf plankton; (b) in these respects, the slope plankton are intermediate but closer to the condition of the deep Gulf; and (c) each of the three regions is characterized by some planktonic species that are more or less specific to a particular zone. Some east-west differences have been noted, especially among the diatom species. These species have also been interpreted as representing the differences between normal Gulf waters and those influenced by Mississippi River water (Pequegnat, 1983).

Most of the benthic fauna of the deep slope and abyssal plain are restricted to these depths and not found elsewhere. The 450-m isobath defines the truly deep-sea fauna. The deep-water benthic fauna have been characterized into seven faunal assemblages by Pequegnat (1983) and confirmed by LGL Ecological Research Associates, Inc. and Texas A&M University (1986):

> The Shelf/Slope Transition Zone (150-450 m) is a very productive part of the benthic environment. Demersal fish are the dominant species, many of them reaching their maximum populations in the zone. Asteroids, gastropods, and polychaetes are common.
>
> The Archibenthal Zone - Horizon A Assemblage is located between 475 and 750 m. Although less abundant, the demersal fish are a major constitutent of the fauna, as are gastropods and polychaetes. Sea cucumbers are more numerous. Horizon B, located at 775-950 m, represents a major change in the number of species of demersal fish, asteroids, and echinoids, which reach maximum populations here. Gastropods and polychaetes are still numerous.

The Upper Abyssal Zone is located between 975 and 2,250 m. Although the number of species of demersal fish drops, the number that reaches maximum populations dramatically increases. This indicates a group uniquely adapted to the environment. Sea cucumbers exhibit a major increase, and gastropods and sponges reach their highest species numbers here.

The topographic and physical oceanographic conditions present at the East Breaks in the Western Gulf are such that a nutrient-rich upwelling could be expected in the vicinity. The NMFS has reported that the area is an important recreational billfishing area. The upwelling may contribute to this fishery.

At the onset of the Mesoabyssal Zone - At Horizon C (2,275-2,700 m) a sharp faunal break occurs. The number of species reaching maximum populations in the zone drops dramatically for all taxonomic groups.

The Mesoabyssal Zone - Horizon D Assemblage, located at 2,725-3,200 m, coincides with the lower part of the steep continental slope in the Western Gulf. Since the Central Gulf is dominated at these depths by the Mississippi Trough and Mississippi Fan, the separation of Horizon C and D assemblages is not as distinct in the Central Gulf. The assemblages differ in species constitution.

The Lower Abyssal Zone is the deepest of the assemblages at 3,225-3,850 m. Megafauna is depauperate. The zone contains an assemblage of benthic species not found elsewhere.

Chemosynthetic communities of the deep sea are discussed in Section III.B.2.b. below.

a. Live Bottoms

Live bottoms are regions of high productivity characterized by a firm substrate with high diversity or density of epibiota. These communities are scattered across the west Florida shelf in the shallow waters with depth zonation apparent in the dominant communities, and within restricted regions of the Central Gulf. The density of the epibiotal communities varies from diffuse to 100 percent coverage of the bottom, largely depending on bottom type, current regimes, suspended sediments, habitat availability, as well as anthropogenic and meteorological perturbations. Sessile epibiota include seagrasses, algae, sponges, anemones, encrusting bryozoans, and associated communities. For the purposes of this document, live bottoms also include biological assemblages consisting of sea fans, sea whips, hydroids, ascidians, or corals living upon and attached to naturally occurring hard or rocky formations with rough, broken, or smooth topography; or areas whose lithotope favors the accumulation of turtles, fishes, seagrasses, algae, and other fauna. The faunal assemblages of the Eastern Gulf are markedly different from those of the Central Gulf. The difference is attributed to the calcareous sediments found east of DeSoto Canyon as opposed to the terrigenous muds and sands of the Central and Western Gulf and the influence of the upwelling associated with the Loop Current.

Central Gulf of Mexico

The northeastern portion of the Central Gulf exhibits a band of pinnacles, the "pinnacle trend," between 67 and 110 m (220 and 360 ft) depth, as shown in Figure III-3 and on the reverse of Visual No. 2E. The pinnacles appear to be carbonate reefal structures in an intermediate stage between growth and fossilization (Ludwick and Walton, 1957). The region contains a variety of features from low to major pinnacles, as well as ridges, scarps, and relict patch reefs. It has been postulated that these features were built during lower stands of the sea during the rise in sea level following the most recent ice age. The heavily indurated pinnacles provide a surprising amount of surface area for the growth of sessile invertebrates and attract large numbers of fish.

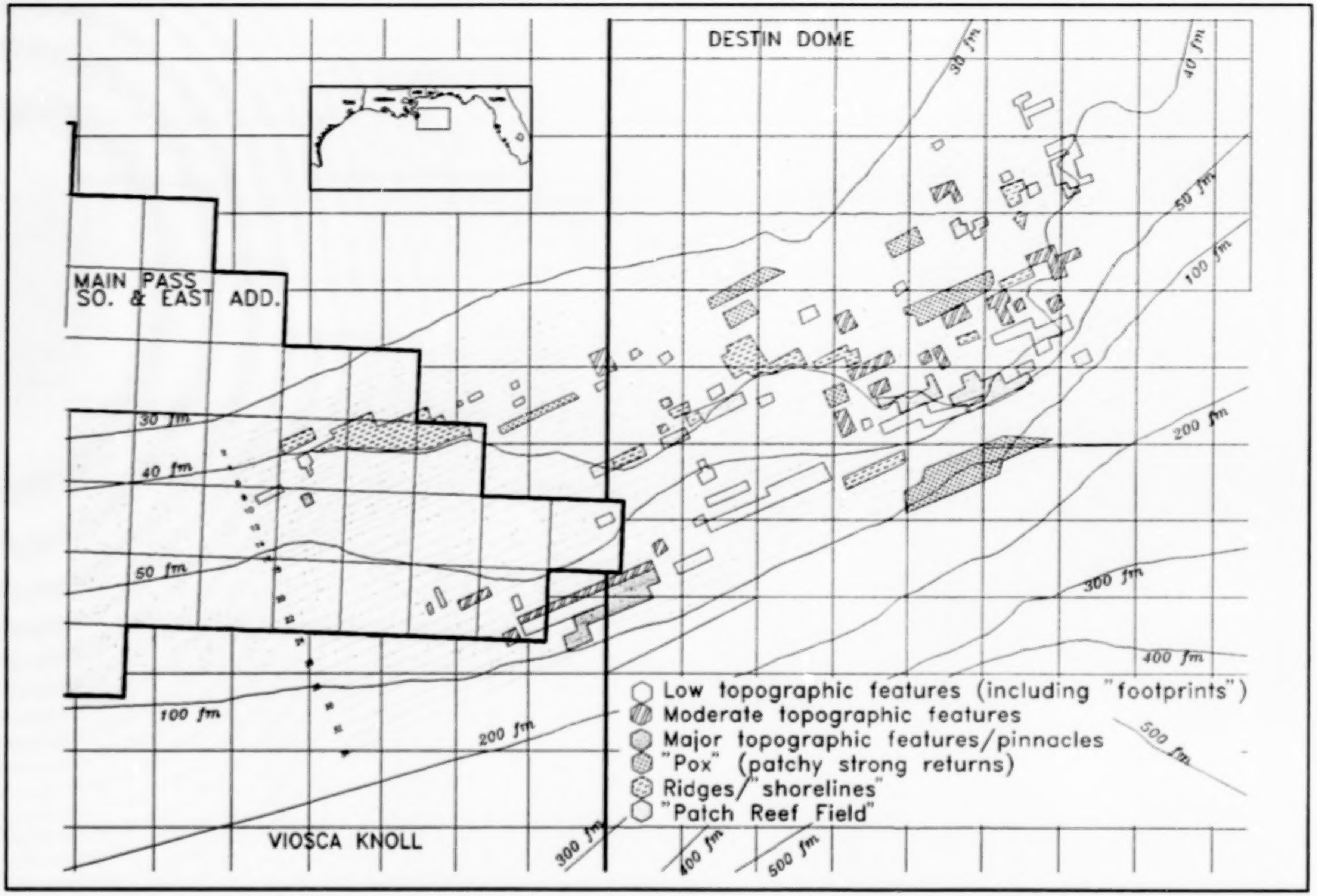

DESTIN DOME
MAIN PASS
SO. & EAST ADD.
VIOSCA KNOLL
30 fm
40 fm
50 fm
100 fm
200 fm
300 fm
400 fm
500 fm
Low topographic features (including "footprints")
Moderate topographic features
Major topographic features/pinnacles
"Pox" (patchy strong returns)
Ridges/"shorelines"
"Patch Reef Field"

Figure III-3. Pinnacle Trend Features Identified by the Mississippi-Alabama Marine Ecosystem Study (Shaded Areas Indicate Blocks Affected by Potential Live-Bottom Stipulations).

The pinnacles are found at the outer edge of the Mississippi/Alabama shelf between the Mississippi River and the DeSoto Canyon. The bases of the pinnacles rise from the seafloor between 50 and 100 m with vertical relief of 20 m. These features exist in turbid water and contain limited biotal coverage. Pinnacles photographed in 1985 by CSA showed biota similar to the transitional antipatharian-zone assemblage described by Rezak (CSA, 1985). These pinnacles may provide structural habitat for a variety of pelagic fish. Schroeder et al. (1988) have noted the diversity of habitat types in the offshore waters of Mississippi/Alabama. The MMS, through the studies program, is further studying the extent and importance of the pinnacle area.

With the exception of the region defined as the pinnacle-trend areas, the substrate in waters shallower than 67 m of the Central Gulf is a mixture of mud and/or sand (Vittor and Associates, Inc., 1985). The live-bottom surveys required by MMS and conducted in the eastern portions of the area have also revealed sand or mud substrate. These areas are not conducive to "live-bottom" community growth since a hard substrate is needed for epifaunal attachment. As the substrate grades to carbonate sand in the Eastern Gulf, the potential for "live bottoms" increases.

The following description of the pinnacle-trend region is taken from the ongoing Mississippi/Alabama Marine Ecosystems Study (MAMES), as described by Brooks et al. (1989).

> Biological assemblages dominated by tropical hard bottom organisms and reef fishes occupy a variety of topographic features that exist between 60 and 110 m in the northeastern Gulf of Mexico between the Mississippi River and the DeSoto Canyon. The origins of the carbonate features vary. Some are small, isolated, low to moderate reefal features or outcrops of unknown origin. Some appear to be hard substrates exposed by erosion during sea level still-stands along late Pleistocene shorelines. Others appear to be small reefs that existed near these shorelines. The largest features appear to have been offshore reefs. Formation of the largest features probably occurred prior to the Holocene Transgression. Some additional growth of these features and growth of other smaller reefs on exposed substrates may have taken place during the early transgressional period. The structure of the summits of some reefs may also have been modified by Holocene erosional events following their initial period of growth (namely, the flat-topped reefs). Most currently appear to be deteriorating under the influence of bioerosional processes.
>
> The hermatypes that contributed to the development of these structures probably included coralline algae, reef-building corals, bryozoans, foraminiferans, and molluscs, among others. Present-day production of calcium carbonate is probably limited to an impoverished calcareous algae population on features above 70-75 meters. Features below this depth can most likely be considered completely drowned reefs.
>
> The topographic features in the northeastern Gulf may be of similar age and origin to those that exist in a number areas along the outer continental shelf of the Gulf of Mexico and the east coast of the United States. The depth ranges of many of these features are similar, and most are non-growing reefs inhabited by tropical to warm temperate, hard bottom organisms most commonly found below the depths of living coral reefs.
>
> Present-day biological assemblages on features in the northeastern Gulf are dominated by suspension feeding invertebrates. Populations are depauperate on features of low topography, those in habitats laden with fine sediments, and at the base of larger features (where resuspension of sediments limits community development). On larger features, the diversity and development of communities appears to depend on habitat complexity, that is, containing extensive reef flats on their summits, there are rich assemblages distinguished by a high relative abundance of sponges, gorgonian corals (especially sea fans), crinoids, and bryozoans, Due to the generally accordant depth of flat-topped reefs (62-63 m), coralline algae are also in abundance. Other organisms on reef flats include holothurians, basket stars, and myriads of fish (mostly the roughtongue bass, *Holanthias martinicensis*). On reefs lacking this reef flat habitat, as well as on reef faces of flat-topped features, the benthic community is characterized by a high relative abundance of ahermatypic corals (both solitary and colonial scleractinians). Other frequently observed organisms on these rugged, often vertical reef faces include crinoids, gorgonians, sea urchins, and basket stars.

Human impact in these environments appears to be minimal at present. Discarded debris, though present at many sites, was not abundant, and therefore poses little threat to the environment. Cables and ropes can affect shallower reef communities, but probably have little impact at these depths once they become tangled on or lodged against reefal structures. Fishing pressure on these relatively small features may reduce the population of the larger, commercially important species, and may explain the abundance of smaller individuals of unprofitable species on heavily fished reefs.

Eastern Gulf of Mexico

Although the Eastern Gulf generally does not contain the abundance and diversity of topographic features common to the offshore areas of the Central and Western Gulf, the EPA contains several offshore habitats of particular note. For the purposes of protecting these habitats and associated communtities, these habitats all fall under the general definition of live bottom. The pinnacle-trend live-bottom region and low-relief live bottoms are discussed briefly below. The offshore seagrasses, a third live-bottom habitat, are discussed in Section III.B.1.c., while the Florida Middle Ground is discussed in Section III.B.2.a.

The southwest Florida shelf, in water depths between 10 and 200 m, has been characterized into several biological assemblages that are associated with particular substrates and has shown strong depth affinities. The relationship of these assemblages to substrate type and water depths is shown in Figure III-4. Although depth is probably not a decisive factor in determining the distribution of the biotic assemblages, three major biotic depth zones are evident. There appears to be an inner-shelf zone between 10 and 60 m water depth, a transitional zone between 60 and 90 m, and an outer-shelf zone from 90 to 200 m (Woodward-Clyde Consultants and CSA, 1984; CSA, 1986). A brief description of each assemblage follows. The two assemblages associated with sand bottoms exhibit an epifaunal density of less than one individual per square meter (Woodward-Clyde Consultants and CSA, 1984; CSA, 1986). These assemblages are not considered live bottoms as defined in the lease stipulations for proposed Sale 137.

Inner and Middle Shelf Sand-Bottom Assemblage. Biota found on the sand bottom substrates is solitary or in widely scattered patches. Algae, asteroids, bryozoans, corals, echinoids, sea fans, and sponges have been recorded within this assemblage. This assemblage has been found in the sand bottom areas among the Inner Shelf Live-bottom Assemblage I, Inner and Middle Shelf Live-bottom Assemblage II, and Middle Shelf Algal Nodule Assemblage (Woodward-Clyde Consultants and CSA, 1984; CSA, 1986).

Outer Shelf Sand-Bottom Assemblage. This deeper water sand bottom assemblage differs from the Inner Shelf Sand Bottom Assemblage by a lack of macroalgae. Epifauna of this assemblage includes asteroids, crinoids, echinoids, ophiuroids, sea fans, anemones, crustaceans, and sponges. The assemblage is interspersed in the Outer Shelf Crinoid Assemblage, Outer Shelf Low-relief Live-bottom Assemblage, and Outer Shelf Prominences Live-bottom Assemblage (Woodward-Clyde Consultants and CSA, 1984; CSA, 1986).

Inner Shelf Seagrass/Algal Bed Live-bottom Assemblage. This assemblage is located in soft-bottom areas. It is typified by seagrass of the genus *Halophila* and various algae. Patches of sessile epifauna may be interspersed within this assemblage in some areas (CSA, 1986).

Inner Shelf Live-bottom Assemblage I - This live-bottom assemblage consists of patches of algae, ascidians, hard corals, gorgonians, hydrozoans, and sponges. Large gorgonians distinguish this assemblage. Biomass is generally greater and the individual organisms larger than in Assemblage II (Woodward-Clyde Consultants and CSA, 1984; CSA 1986).

Inner and Middle Shelf Live-bottom Assemblage II. This assemblage is composed of the same organism groups listed above for Assemblage I; however, the specific genera may vary in the two assemblages. Generally Assemblage II showed a higher number of sponge species and a lower biomass than Assemblage I. The large gorgonians typical of Assemblage I are absent in Assemblage II (Woodward-Clyde Consultants and CSA, 1984; CSA, 1986).

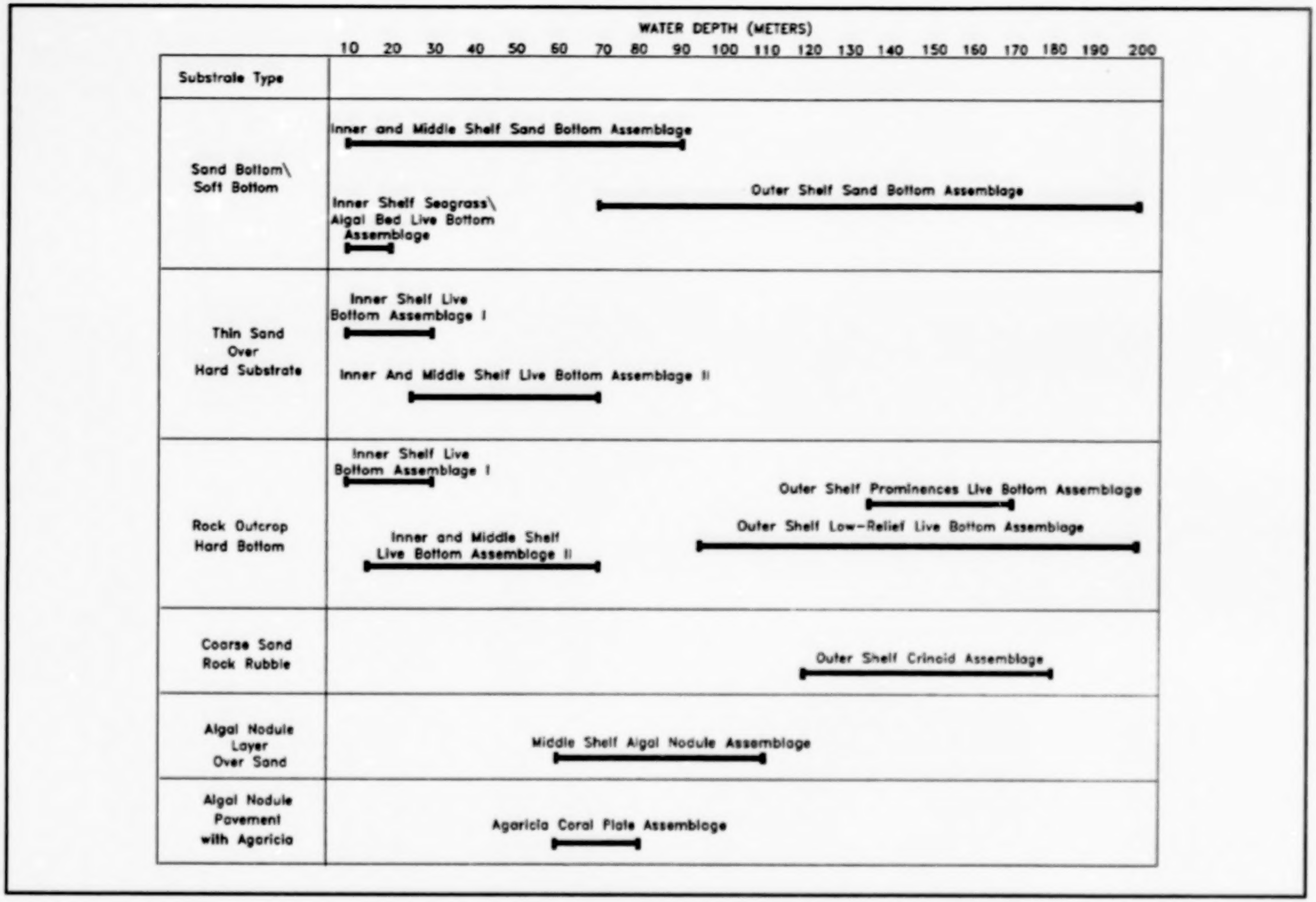


Figure III-4. Biological Assemblages Associated with Substrate Type and Depth in the Eastern Gulf of Mexico.

Outer Shelf Low-relief Live-bottom Assemblage. This assemblage is located on low-relief rock surfaces with a sand veneer. Organisms in the assemblage include octocorals, antipatharians, crinoids, and sponges (Woodward-Clyde Consultants and CSA, 1984; CSA, 1986).

Outer Shelf Prominences Live-bottom Assemblage. The organisms of this assemblage are attached to prominences arising from a sand-covered seafloor with up to 3 m of relief. The prominences are most likely dead coral pinnacles. Typical organisms include an octocoral species, antipatharian corals, a hard coral species, hydrozoans, crinoids, and sponges (CSA, 1986).

Middle Shelf Algal Nodule Assemblage. This assemblage consists of coralline algal nodules, fused into a pavement in some areas, formed by two genera of algae, *Lithophyllum* spp. and *Lithothamnium* spp., combined with sand, silt, and clay particles. Other algae are abundant. Hard corals and sponges are present (Woodward-Clyde Consultants and CSA, 1984; CSA, 1986).

Agaricia Coral Plate Assemblage. This assemblage consists of dead, hard coral-coralline algae substrate covered with living algae, hard corals, gorgonians, and sponges (Woodward-Clyde Consultants and CSA, 1984; CSA, 1986).

Outer Shelf Crinoid Assemblage. This assemblage consists of large numbers of crinoids and some small sponges living on coarse sand or rock rubble substrate (Woodward-Clyde Consultants and CSA, 1984; CSA, 1986).

Although the preceding discussion of scattered live-bottom areas applies specifically to the southwest Florida shelf, similar communities may be expected throughout the Eastern Gulf. The depth ranges and species may vary with the changes in latitude; however, since the substrate characteristics are similar in the Eastern Gulf, the biological assemblages are expected (and have been found) to be comparable. It is also of considerable value to note that the most dense and productive of these live-bottom communities fall within waters shallower than 100 m.

The pinnacle-trend region, described for the Central Gulf, continues into the northwestern portion of the Eastern Gulf. However, the majority of the habitats of concern fall within the 100-m isobath and would be covered by the proposed Live Bottom Stipulation.

b. Deep-water Benthic Communities

Chemosynthetic clams, mussels, and tube worms, similar (but not identical) to the hydrothermal vent communities of the eastern Pacific (Corliss et al., 1979) have been discovered in the deep waters of the Gulf and have been the subject of numerous MMS site-specific reviews. These cold-water communities are associated with seismic wipe-out zones and hydrocarbon-seep areas between water depths of 400 and 1,000 m (Kennicutt and Gallaway, 1985; Brooks et al., 1986a). Clams of the genus *Calyptogena*, probably *C. ponderosa*, were identified from the Gulf seep communities. Chemosynthetic worms from the family Lamellibrachiidae and a new undescribed family were found in the Gulf seep communities. The seep communities are characterized by white bacterial mats; large dense beds of tube worms, clams, and mussels; numerous small gastropods; and galatheid crabs (Kennicutt and Gallaway, 1985; LGL Ecological Research Associates, Inc. and Texas A&M University, 1986).

After the initial discovery of the chemosynthetic organisms in the Central Gulf, 12 trawls were conducted by Texas A&M University in the Green Canyon Area in 300- to 500-m water depth. Chemosynthetic organisms were collected at most of these trawl transects. Additionally, through separately funded studies, phototransects documented the location of chemosynthetic organisms at various widespread locations in the Green Canyon Area in water depths from 450 to 950 m. The Offshore Operators Committee funded a study through Texas A&M University (Brooks et al., 1986b) to determine the extent of these communities in the Gulf and their correlation with hydrocarbon seepage. This study included 39 stations located between 180- and 900-m water depth and included the East Breaks, Garden Banks, Green Canyon, Ewing Bank, Atwater Valley, and Mississippi Canyon lease areas. Thirty of the stations sampled exhibited shallow seismic wipe-out zones (wipe-out zones are characteristic of gas-charged, hydrate-containing, and oil-stained sediments). Of the 39 stations sampled, 28 yielded chemosynthetic organisms. Only two of the nonchemosynthetic stations exhibited conditions where chemosynthetic communities might be expected, that is, wipe-out zones, oil-stained sediments, gas pockets, or sediment H_2S odor. The study indicates that there is a strong correlation between seismic wipe-out zones and the occurrence of chemosynthetic communities. Chemosynthetic organisms can thus be expected to occur on or near these wipe-out zones throughout the Gulf where water depths are comparable to the study area. Additionally, chemosynthetic organisms are widespread throughout the deep slope, although normally concentrated in very sparse concentrations of less than one animal per m^2 (Brooks et al., 1986b).

In late 1986, LGL Ecological Research Associates, Inc., and Texas A&M University conducted further surveys as part of the MMS deep-sea study using the research submersible *Johnson-Sea Link I.* The surveys discovered a surprisingly large and diverse community of chemosynthetic tube worms and mussels at a site of natural petroleum and gas seepage, over a salt diapir, in Green Canyon Block 185. The seep site, dubbed Bush Hill, is a small knoll that rises about 40 m above the surrounding seafloor of about 540-m water depth. The following description of this community, the densest and most diverse so far discovered, is from Brooks et al. (1989):

> The sediment in this area consists of silty-clay and is of considerable thickness, although much of the sedimentary facies have been wiped out by rising gas and liquid and by *in situ* formation of authigenic carbonate and sulfides.
>
> The sediments of the depauperate periphery are pale ochre with an easily disturbed flocculent layer. Traces of fish are seen, including burrows and shallow depressions and mounds, but very few organisms are seen. Carbonate outcroppings can be seen, ranging from rubble to prominent boulders. The larger boulders are topped by gorgonians, which are in turn frequently encrusted by large ophiuroids. Large colonies of the scleractinian coral *Lophelia* sp. are also seen attached to the exposed portions of the boulders. Filigreed patches of bacteria can be observed on the sediments. Closer to regions of greater community density, the bacteria patches increase in area and are interspersed with the slender (3.5 mm) black tubes of a pogonophoran tube worm. The most prominent feature of the dense area of the community are bushes of tube worms.
>
> Two species of vestimentiferan tube worms have been collected from Bush Hill. An undescribed mytilid mussel forms discrete beds on both soft sediments and among carbonate outcroppings. Mussels and tube worms have been observed together; however, the larger mussel beds usually contain only stunted tube worms, if any. The beds are irregular in shape, often in close proximity to each other, and range in area from less than 1 m^2 to approximately 20 m^2.
>
> Streams of bubbles, primarily methane, can be observed escaping from the substrate, both within the mussel beds and in their immediate vicinity. Some of these bubble streams are intermittent releases; others continued throughout the period of observation. Disturbance of the bottom in the vicinity of methane streams can cause the release of large oil globules, which float upward. Such releases of oil can also be observed in other locations, usually as a result of some disturbance of the bottom. A dense orange-colored mat of bacteria often covers the oily sediments.
>
> A diverse assemblage of common slope fauna has been observed at Bush Hill. Bathypelagic organisms include tunicates, squid, and trichiurid fishes. Crustaceans include decapod crabs, shrimp, and a giant isopod (*Bathynomous gigas*).

Other chemosynthetic sites have similar biota, although none known are so dense and diverse as Bush Hill.

Investigations into these new and interesting areas continue. Brooks et al. (1987) showed that the worms, clams, and mussels contain autotrophic bacterial symbionts. The worms and clams contain intracellular sulphur bacterial symbionts, while the mussel symbionts are methane based. Evidence for the presence of nitrogen-fixing bacteria in the community was also presented. Kennicutt et al. (1988) demonstrated the relationship between the chemical environment induced by hydrocarbon seepage (H_2S, CH_4, and oil) and chemosynthetic processes on the deep slope. These environments are closely linked to the massive seepage of oil and gas (and can be detected in the geophysical record by the presence of "wipe-out" zones) and the resulting anaerobic, H_2S-rich sedimentary conditions. The natural seepage of hydrocarbons may represent a significant source of hydrocarbons to the deep oceans, and chemosynthetic biomass appears to be an important component of the slope ecology in the areas studied. MacDonald et al. (1989) demonstrated a very close relationship between the density of tube worms and mussels and concentration of organic material derived from the seep. Brooks et al. (1989) described the chemosynthetic communities studied by their group at Texas A&M University, including Bush Hill, described above.

Similar communities have also been discovered in the Eastern Gulf, at the base of the Florida Escarpment, in 3,270-m water depth (Paull et al., 1984). These, too, have been shown to rely on chemosynthesis for organic production (Paull et al., 1985).

The following description of these scarp communities is from Hecker (1985):

> These communities are in cold, sulfide-rich, hypersaline water which appears to be seeping out at the juncture of the escarpment and the abyssal plain sediment. No obvious flow or density differences such as shimmering water were discerned, nor did the water, directly in contact with the animals, show any temperature anomalies. The community in the vicinity of the seep is dominated by dense beds of large mussels and vestimentiferan worm thickets. Fauna associated with these dense aggregations include crabs, other bivalves, mollusks, polychaetes, shrimp, anemones, among others. In terms of dominant taxa and their exceptionally high densities, this seep community is strikingly similar to the vent communities found in the eastern Pacific.
>
> The seep community organisms are concentrated within a 20-30 m wide band along the base of the escarpment and, in places, extend several meters up the escarpment face. Throughout the explored area elongate fan-shaped patches of dark, iron sulfide-rich sediment extend out from the escarpment base. A soft, white, loosely aggregated material resembling bacterial mats frequently covers portions of the sediment. Large golden-brown mytilid mussels, up to 20 cm long, occur in a narrow band along the base of the escarpment and out onto the abyssal plain. Live mussels occur only on the darkened sediment. The mussel beds are exceptionally dense, frequently forming mats several individuals deep. Small gastropods about 1 cm long are numerous with as many as 30 being found on individual live mussels. A variety of other organisms also are associated with the mussel beds, including a large gastropod, small limpets, small shrimp, and anemones.
>
> In addition to the mussel beds, dense thickets of vestimentiferan worms, up to 1 m in length and 1 cm wide at the anterior end, line the vertical cracks and fissures at the base of the scarp, as well as in large clumps on the sediment. The bases of the vestimentiferans are frequently, but not always, interspersed among the mussels. Soft corals and small anemones were frequently seen on the tubes, and large white crabs were frequently seen crawling over and among the worms and mussels.
>
> The demarcation between the fauna of the seep community and that of the adjacent abyssal plain is pronounced. The abyssal-plain fauna consist of sparse populations of a red holothurian, red shrimp, small anemones, sea pens, and small crabs. The sharp boundary of the seep community is marked by an accumulation of dead mussel and gastropod shells. Individuals of the abyssal-plain fauna were not observed inside this boundary, possibly

> indicating toxicity of the seep environment to organisms that are not specifically adapted to it. The seep organisms were found only within the narrow band at the base of the escarpment, which is marked by darkened sediment on the abyssal floor, and in fissures in the escarpment face. Even the relatively mobile crabs were not seen far outside the boundaries of this community.

Cary et al. (1989) have shown that although the vestimentiferan worm and the mussel live contiguously, they rely on different substrates for chemoautotrophy. A variety of analytical methods indicate that the tube worm relies on sulfide oxidation and the seep mussel on methane oxidation for growth.

Chemosynthetic communities have been a source of controversy over the past few years, in part because of the unusual environmental requirements and the hypothesized sensitivity of the communities to oil and gas activities. The MMS requires site-specific surveys of bottom-disturbing actions in water depths greater than 400 m in order to judge the potential of the region for supporting chemosynthetic organisms. Figures III-5 and III-6 delineate the regions of the Gulf of Mexico in which these reviews have been made. The review of site-specific activities has been accomplished since 1984, with over 80 blocks examined to date. NTL 88-11, issued by the MMS Gulf of Mexico OCS Regional Office in late 1988 and effective on February 1, 1989, formalized the process. The NTL was published and mailed to all affected leaseholders. (For a discussion of the NTL, see Sections IV.D.1.a.(2)(b), IV.D.2.a.(2)(a), and IV.D.3.a.(2)(b).)

c. Topographic Features

The shelf and shelf edge of the Central and Western Gulf are characterized by topographic features that are inhabited by benthic communities (Figure III-7). The habitat created by the topographic features is important in several respects: they support hard-bottom communities of high biomass, high diversity, and high numbers of plant and animal species; they support, either as shelter, food, or both, large numbers of commercially and recreationally important fishes; they are unique to the extent that they are small, isolated areas of such communities in vast areas of much lower diversity; they (especially the East and West Flower Garden Banks) provide a relatively pristine area suitable for scientific research; and they have an aesthetically attractive intrinsic value.

The benthic organisms on these features are temperature and light limited. The 16°C-isotherm is stressful for most coral and is considered the lower limit for coral growth (Rezak et al., 1983). Elevated temperatures can also cause thermal stress by causing the corals' zooxanthellae to be expelled. Where light is limited, coral growth is inhibited. Therefore, coral growth is limited by water depth and by distance from surrounding substrate and nepheloid layer. Because the coral communities must be close enough to the surface of the water for adequate light penetration and yet removed from the seafloor to escape the effects of the nepheloid layer, the topographic features (or banks) present the proper conditions for coral growth.

Rezak et al. (1983 and 1985) identified seven distinct biotic zones on the banks of the Gulf. None of the banks contain all of the seven zones. The zones are divided into the following four categories dependent upon the degree of reef-building activity in each zone.

Zones of Major Reef Building and Primary Production

Diploria-Montastrea-Porites Zone

This zone is characterized by 18 hermatypic coral species. The dominant species of the zone in order of dominance are *Montastrea annularis*, *Diploria strigosa*, *Montastrea cavernosa*, *Colpophyllia* spp., and *Porites asteroides*. The biotic zone was named before the order of dominance was known; therefore, the name does not reflect the true order of dominance. Coralline algae are abundant in the *Diploria-Montastrea-Porites* Zone, adding substantial amounts of calcium carbonate to the substrate. Leafy algae are sparse, probably due to grazing. Typical sport and commercial fish that frequent the *Diploria-Montastrea-Porites* Zone include grouper, hind, amberjack, barracuda, red and vermilion snapper, cottonwick, porgy, and creole fish. This high-diversity coral-reef zone is found only at the East and West Flower Garden Banks in water depths less than 36 m.

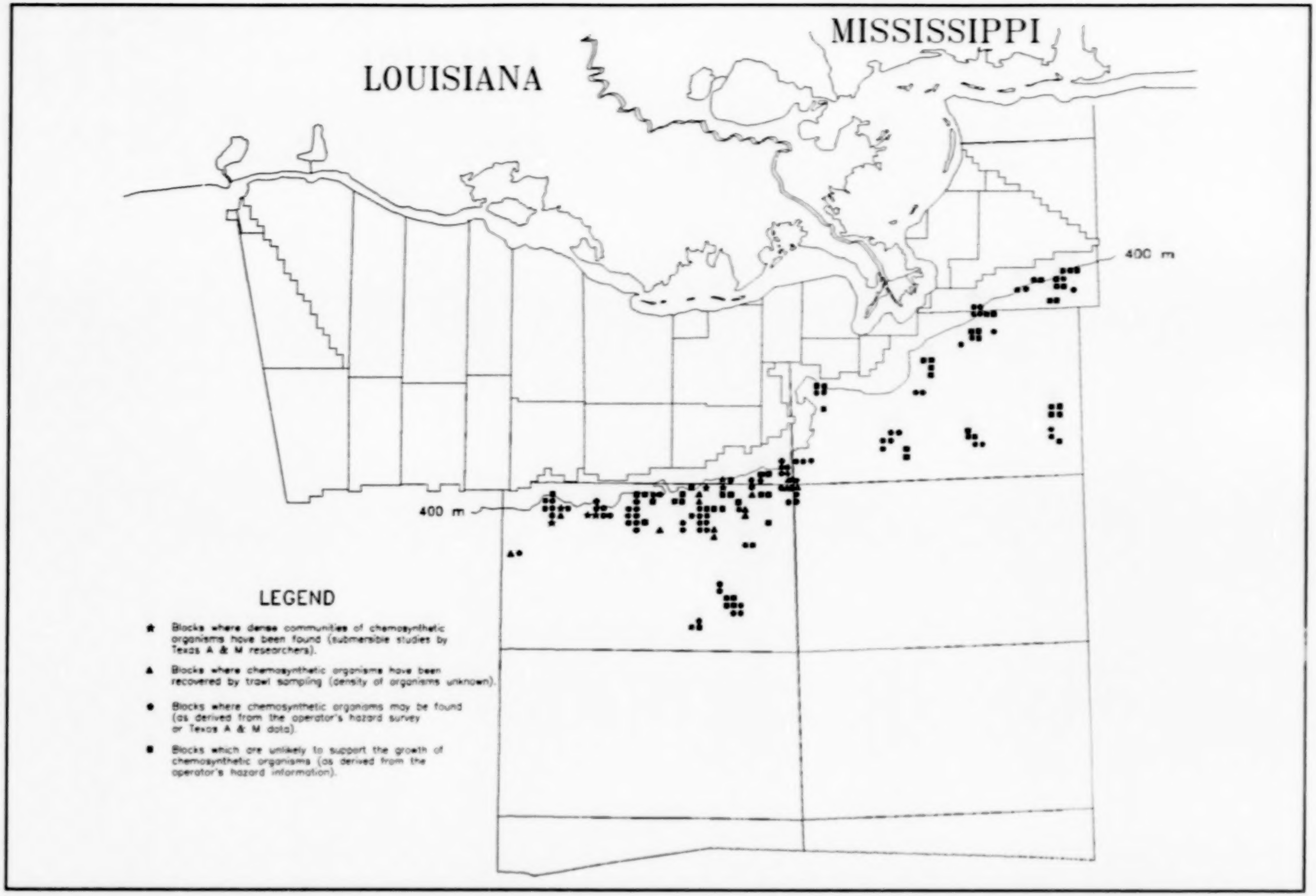

MISSISSIPPI
LOUISIANA
400 m
400 m
LEGEND
★ Blocks where dense communities of chemosynthetic organisms have been found (submersible studies by Texas A & M researchers).
▲ Blocks where chemosynthetic organisms have been recovered by trawl sampling (density of organisms unknown).
● Blocks where chemosynthetic organisms may be found (as derived from the operator's hazard survey or Texas A & M data).
■ Blocks which are unlikely to support the growth of chemosynthetic organisms (as derived from the operator's hazard information).

Figure III-5. Location and Description of Chemosynthetic Communities in the Central Gulf of Mexico.

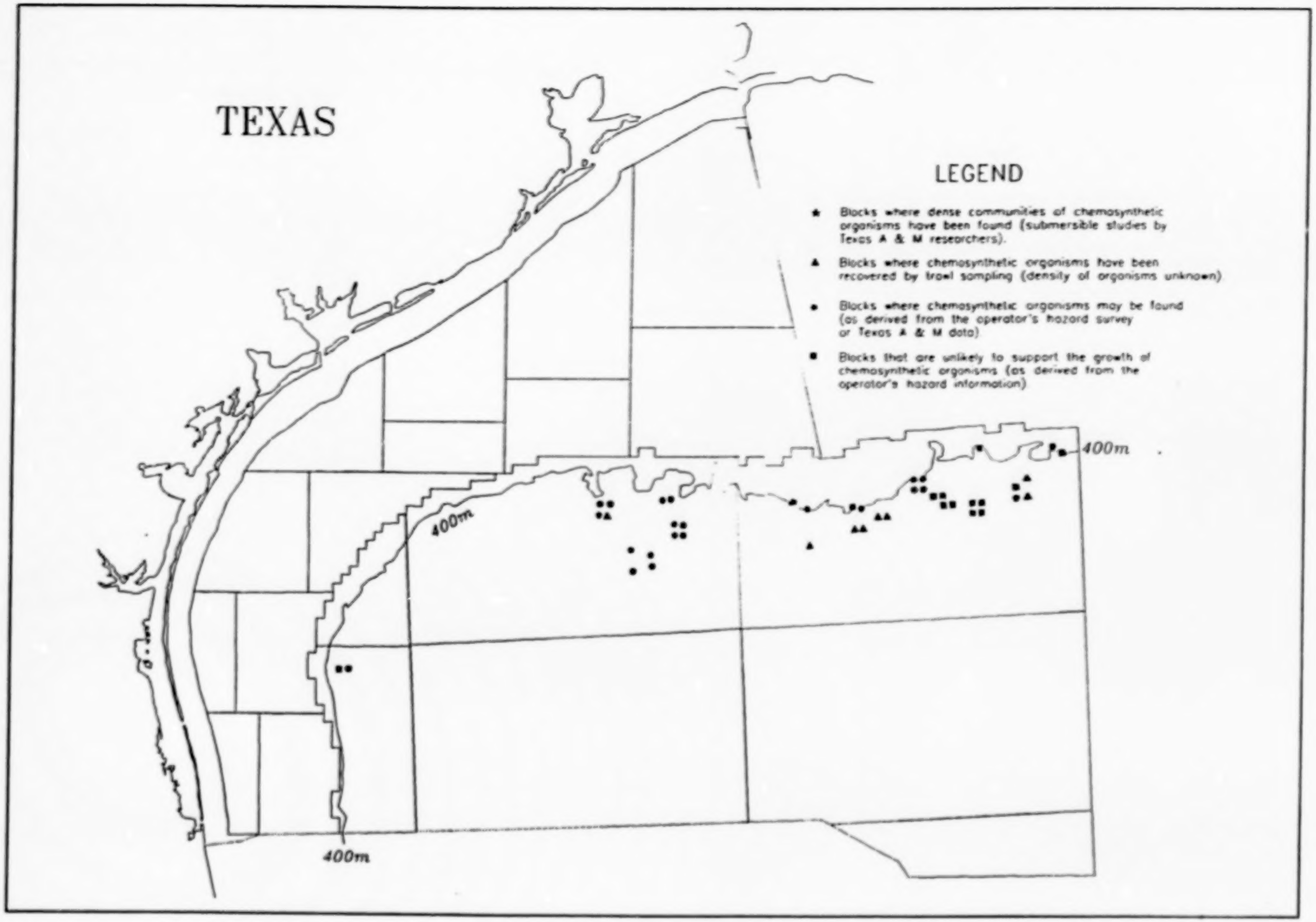

TEXAS
LEGEND
★ Blocks where dense communities of chemosynthetic organisms have been found (submersible studies by Texas A & M researchers).
▲ Blocks where chemosynthetic organisms have been recovered by trawl sampling (density of organisms unknown)
● Blocks where chemosynthetic organisms may be found (as derived from the operator's hazard survey or Texas A & M data)
■ Blocks that are unlikely to support the growth of chemosynthetic organisms (as derived from the operator's hazard information)
400m
400m
400m

Figure III-6. Location and Description of Chemosynthetic Communities in the Western Gulf of Mexico.

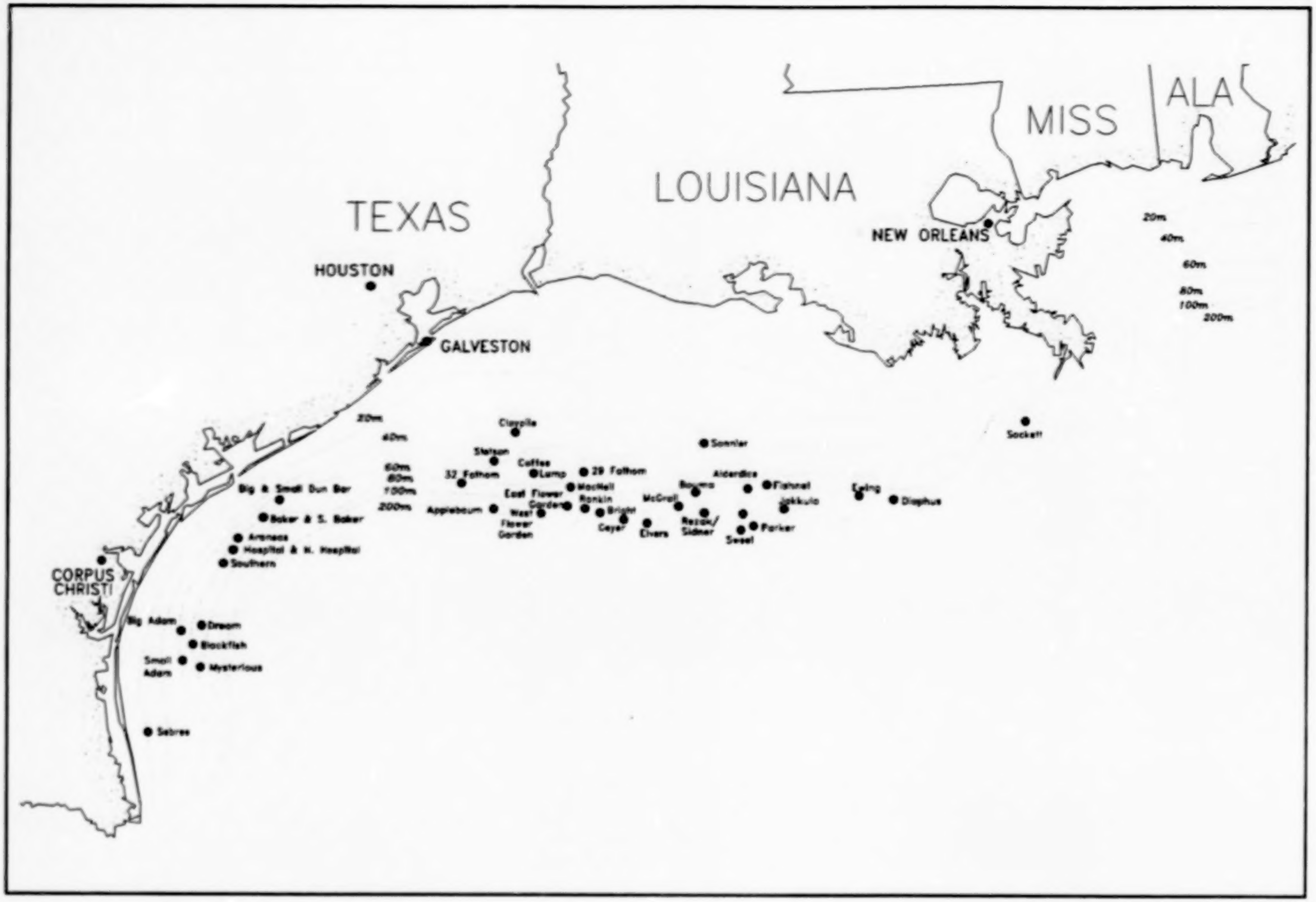


Figure III-7. Location of Topographic Features.

Madracis Zone and Leafy Algae Zone

The *Madracis* Zone is dominated by the small branching coral *Madracis mirabilis*, which produces large amounts of carbonate sediment. In places, large (possibly ephemeral) populations of leafy algae dominate the *Madracis* gravel substratum (Leafy Algae Zone). The *Madracis* Zone appears to have a successional relationship with the *Diploria-Montastrea-Porites* Zone. *Madracis* remains build up the substrate and allow the successional species to grow. The zone occurs at the Flower Gardens on peripheral parts of the main reefal structure between 28 and 46 m.

Stephanocoenia-Millepora Zone

The *Stephanocoenia-Millepora* Zone is inhabited by a low-diversity coral assemblage of 12 hermatypic corals. The eight most conspicuous corals in order of dominance are *Stephanocoenia michelinii*, *Millepora* sp., *Montastrea cavernosa*, *Colpophyllia* spp., *Diploria* sp., *Agaricia* spp., *Mussa angulosa*, and *Scolymia* sp. The assemblages associated with the *Stephanocoenia-Millepora* Zone are not well known. Coralline algae are most conspicuous in this zone. Reef fish populations are less diverse. The American thorny oyster (*Spondylus americanus*) appears numerous in the zone. The lower diversity coral reefs are found at the Flower Gardens, McGrail Bank (formerly 18 Fathom Bank), and Bright Bank. The depth range of this zone is between 36 and 52 m.

Algal-Sponge Zone

The Algal-Sponge Zone is the largest of the reef-building zones in terms of area. The dominant organisms of the zone are the coralline algae, which are the most important carbonate-nodule producers. The algae nodules range from 1-10 cm in size and cover 50-80 percent of the bottom. The depth range of this zone at each bank varies depending on the conditions at the bank, but generally the range is between 55 and 85 m. The habitat created by the algae nodules supports communities that are probably as diverse as the coral-reef communities. Most of the leafy algae found on the banks occur in this zone and contribute large amounts of food to the surrounding communities. In addition to the coralline algae, calcareous green algae (*Halimeda* and *Udotea*) and several species of hermatypic corals are major contributors to the substrate. Deep-water alcyonarians are abundant in the lower Algal-Sponge Zone. Sponges, especially *Neofibularia nolitangere*, are conspicuous. Echinoderms are abundant and also add to the carbonate substrate. Small gastropods and pelecypods are also abundant. Gastropod shells are known to form the center of some of the algal nodules. Characteristic fish of the Algal-Sponge Zone are yellowtail reeffish, sand tilefish, cherubfish, and orangeback bass.

Partly drowned reefs are a major biotope of the Algal-Sponge Zone. They are defined as those reefal structures covered with living crusts of coralline algae with occasional heads of hermatypic corals. In addition to the organisms typical to the rest of the Algal-Sponge Zone, the partly drowned reefs are also inhabited by large anemones, large comatulid crinoids, basket stars, limited crusts of *Millepora*, and infrequent small colonies of other hermatypic species.

Zone of Minor Reef Building

Millepora-Sponge Zone

The *Millepora*-Sponge Zone occupies depths comparable to the *Diploria-Montastrea-Porites* Zone on the claystone-siltstone substrate of the Texas-Louisiana midshelf banks. One shelf-edge carbonate bank, Geyer Bank, also exhibits the zone but only on a bedrock prominence. Crusts of the hydrozoan coral, *Millepora*, sponges, and other epifauna occupy the tops of siltstone, claystone, or sandstone outcrops in this zone. Scleractinian coral heads and coralline algae are rare.

Transitional Zone of Minor to Negligible Reef-Building

Antipatharian Zone

This transitional zone is not distinct but blends in with the lower Algal-Sponge Zone. It is characterized by an abundance of antipatharian whips growing with the algal-sponge assemblage. With increased water depth, the assemblages of the zone become less diverse, characterized by antipatharians, comatulid crinoids, few leafy or coralline algae, and limited fish (yellowtail redfish, queen angelfish, blue angelfish, and spotfin hogfish). Again, the depth of this zone varies at the various banks but extends generally to 90 m.

Zone of No Reef Building

Nepheloid Zone

High turbidity, sedimentation, and resuspension occur in this zone. Rocks or drowned reefs are covered with a thin veneer of sediment. Epifauna are scarce. The most noticeable are comatulid crinoids, octocoral whips and fans, antipatharians, encrusting sponges, and solitary ahermatypic corals. The fish fauna are different and less diverse than those of the coral reefs or partly drowned reefs. These fish species include red snapper, spanish flag, snowy grouper, bank butterflyfish, scorpionfishes, and roughtongue bass. This zone occurs on all banks, but its depth differs at each bank. Generally, the Nepheloid Zone begins at the limit of the Antipatharian Zone and extends to the surrounding soft bottom.

Figure III-7 depicts the location of the topographic features in the Western and Central Gulf. Table III-5 describes the biotic zones found or expected at each bank and gives the depths of the bank crest and surrounding seafloor.

Of the topographic features depicted in Figure III-7, 16 are located in the Central Gulf:

Shelf-Edge Banks

Bright Bank
McGrail Bank
Rankin Bank
Alderdice Bank
Rezak Bank
Sidner Bank
Ewing Bank
Jakkula Bank
Bouma Bank
Parker Bank
Sackett Bank
Diaphus Bank
Sweet Bank

Midshelf Banks

Sonnier Bank
29 Fathom Bank
Fishnet Bank

(Rankin and 29 Fathom Banks are located along the dividing line between the Central and Western Gulf and, therefore, are considered on both.)

The shelf-edge banks generally exhibit the zonation exhibited at the Flower Garden Banks at comparable depths.

Three of the Central Gulf banks are classified as midshelf banks: Sonnier, 29 Fathom, and Fishnet Banks. Because their midshelf location results in lowered light penetration and temperature minimum, the biotic zones do not correspond to the same zones at similar depths on the Flower Gardens. Instead of the high-diversity coral-reef zone found at the Flower Gardens, the midshelf banks at similar depths exhibit the lower diversity Millepora-sponge zone. This zone is evident at Sonnier Bank in the Central Gulf. (Sonnier Bank

Table III-5

Biotic Zones of Topographic Features with Bank Crest and Seafloor Depth in Meters

	Millepora-Sponge	*Diplora Montastrea*-*Porites*	*Madracis*	*Stephanocoenia*	Algal-Sponge	Transitional	Antipatharian-Nepheloid	Seafloor
Shelf Edge Banks								
East Flower Garden		15	X	X	X	X	X	100-120
West Flower Garden		20	X	X	X	X	X	110-130
Bright				37	X	X	X	110
McGrail				45	X	X	X	110-130
Geyer	37				X	X	X	190-210
Rankin					52	X	X	110-140
Alderdice					55	X	X	84-90
Rezak					60	X	X	120
Sidner					55	X	X	150
Ewing					56	X	X	85-100
Jakkula					59	X	X	120-140
Bouma					60	X	X	90-100
Elvers					60	X	X	180
Parker					60	X	X	100
MacNeil					62	X	X	86-94
Sackett					67	X	X	100
Diaphus						73	X	110-130
Sweet					75	X	X	130-200
Applebaum					76	X	X	100-120
Phleger							122	200
Low Relief								
Midshelf Banks								
Claypile	40						X	50
32Fathom						52	X	55
Coffee Lump						62	X	70
Midshelf Banks								
Sonnier	18						X	50
Stetson	20						X	60
29 Fathom						52	X	72
Fishnet						66	X	78
Low Relief								
South Texas Banks								
Sebree							31	37
Big Dunn Bar						61	X	67
Small Dunn Bar						63	X	67
Big Adam						60	X	64
Small Adam						60	X	66
Blackfish						60	X	70-74
Mysterious						70	X	74-86
South Texas Banks								
Baker						56	X	70-74
Aransas						57	X	70-72
Southern						58	X	80
North Hospital						58	X	68-70
Hospital						59	X	70-78
South Baker						59	X	80-84
Dream						62	X	80

Sources: Rezak and Bright, 1981; Rezak et al., 1983.

was inadvertently omitted from Visual No. 3.) Figure III-8 depicts the location of Sonnier Bank in relation to the lease blocks and the protective zonation locations in the Topographic-features Stipulation proposed for Sale 131 (Section II.A.1.c.(1)).

Of the topographic features depicted in Figure III-7, 27 are located in the Western Gulf:

Shelf-Edge Banks

- East Flower Garden Bank
- West Flower Garden Bank
- Geyer Bank
- Rankin Bank
- Elvers Bank
- MacNeil Bank
- Applebaum Bank
- Phleger Bank

Midshelf Banks

- Claypile Lump
- 32 Fathom Bank
- Coffee Lump
- Stetson Bank
- 29 Fathom Bank

South Texas Banks

- Sebree Bank
- Big Dunn Bar
- Small Dunn Bar
- Big Adam Bank
- Small Adam Bank
- Blackfish Ridge
- Mysterious Bank
- Baker Bank
- Aransas Bank
- Southern Bank
- North Hospital Bank
- Hospital Bank
- South Baker Bank
- Dream Bank

The shelf-edge banks generally exhibit the zonation that is exhibited at the Flower Garden Banks at comparable depths. Of interest is Geyer Bank, which crests at 37 m, within the depth that the high-diversity coral-reef zone is expected. However, at this bank, the *Millepora*-sponge zone is evident. The *Millepora*-sponge zone is found elsewhere in the Gulf only at the midshelf banks.

Three of the midshelf banks contain the *Millepora*-sponge zone: Sonnier Bank in the Central Gulf and Stetson and Claypile Banks in the Western Gulf. Claypile Bank, with only 10 m of relief, is considered a low-relief bank and is often enveloped by the nepheloid layer. Thus, the level of development of the *Millepora*-sponge community is lowest at Claypile Bank. Two other midshelf banks in the Western Gulf (32 Fathom Bank and Coffee Lump) have reliefs less than 10 m and are considered to be low-relief banks.

The South Texas banks are geographically/geologically distinct from the shelf-edge banks. Several of the South Texas banks are also low-relief banks. These banks exhibit a reduced biota and have relatively low relief, few hard-substrate outcrops, and a thicker sediment cover than the other banks. Sebree Bank is a low-profile feature located in 36.5 m (120 ft) of water. The highest area of the bank is about 31 m (102 ft) deep. The bank appears composed of large boulders mostly veneered by fine sediments. The low relief of the bank and the fine sediments covering the bank indicate that Sebree Bank frequently exists in turbid conditions. The biota of the bank appears sparse due to these conditions. Specimens of *Oculina diffusa* have been located. The bank attracts abundant nektonic species including red snapper (Tunnel, 1981).

3. Endangered and Threatened Species

Although a large number of endangered and threatened species inhabit the Gulf Coast States and their adjoining waters, only a small percentage occupy coastal and marine habitats. An even smaller number are likely to be affected by OCS oil and gas exploration and development. The FWS and NMFS have noted that the following protected species could potentially be impacted by OCS oil and gas development:

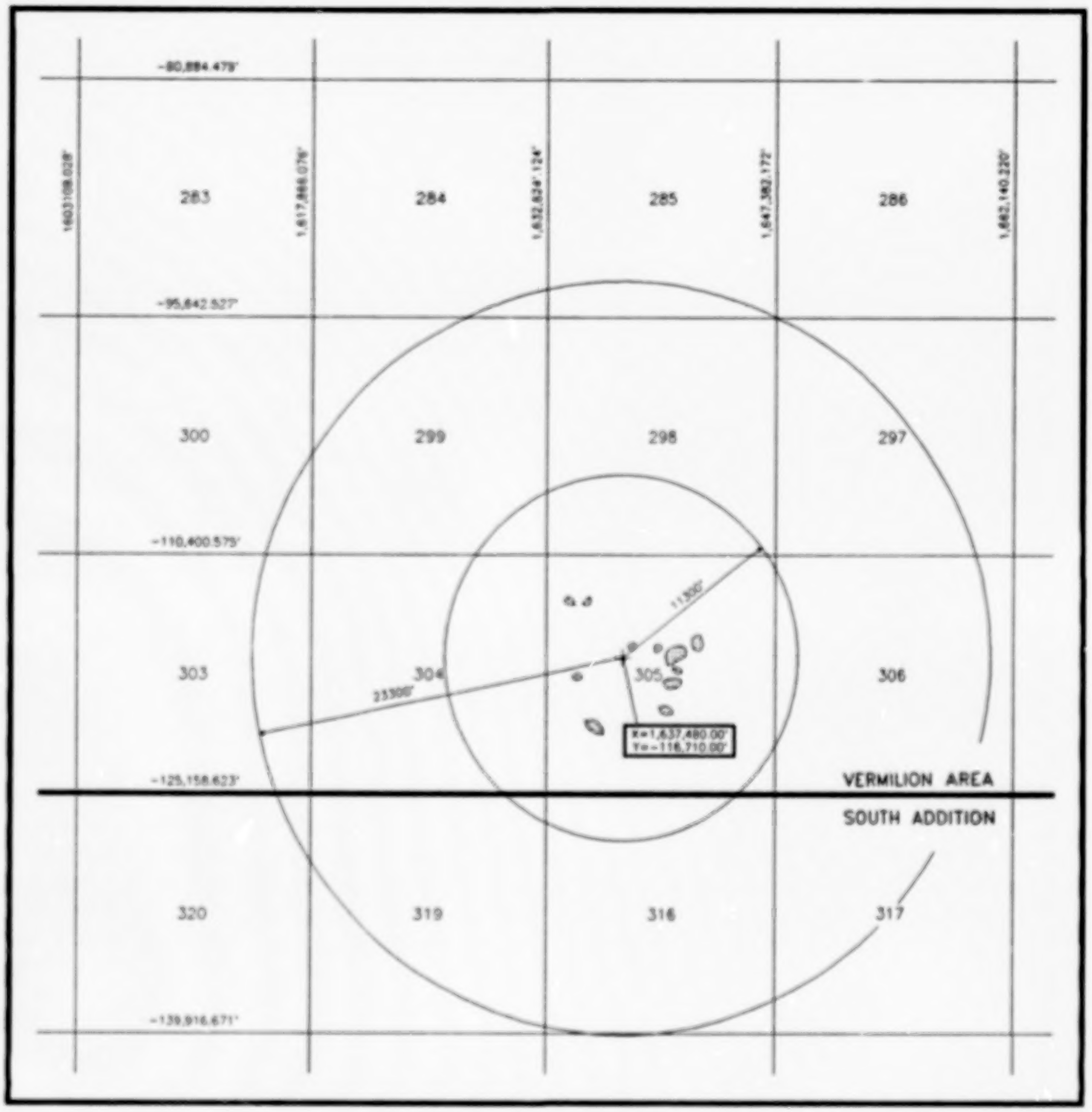


Figure III-8. Sonnier Bank and Protective Zones as Proposed by the Biological Lease Stipulation.

Mississippi sandhill crane
bald eagle
wood stork
West Indian manatee
whooping crane
jaguarundi
Alabama beach mouse
Eskimo curlew
green sea turtle
hawksbill sea turtle
blue whale
humpback whale
sei whale
piping plover
brown pelican
Gulf sturgeon
arctic peregrine falcon
ocelot
Perdido Key beach mouse
Choctawhatchee beach mouse
Kemp's ridley sea turtle
loggerhead sea turtle
leatherback sea turtle
fin whale
right whale
great sperm whale

Fourteen protected species, among them the seven whale species discussed in Section III.B.3.c. below, and one candidate species, the Gulf sturgeon (Section III.B.3.i. below) have been selected for description and analysis because of the potential frequency or severity of their interactions with proposed OCS development. These species include the Kemp's ridley and loggerhead sea turtles, six great whales (blue, fin, humpback, right, sei, and great sperm) piping plover, brown pelican, Eskimo curlew, whooping crane, West Indian manatee, and the Gulf sturgeon (a subspecies of the Atlantic sturgeon).

Five of the protected species--the Alabama beach mouse, Perdido Key beach mouse, Mississippi sandhill crane, jaguarundi, and ocelot--could be impacted only by onshore development because their primary habitat is not on the OCS. These species are not discussed because no significant new onshore development is expected to occur as a result of the proposed sales (Section IV.A.4.). However, if onshore development is proposed, it will be reviewed by MMS and FWS for impacts to protected species on a site-specific basis. The remaining protected species are located south of latitude 26°N and are not described because of the absence of OCS oil and gas activities and the low probability of an oil spill from the proposed sales contacting these species or their habitat.

The following species have been selected for description and analysis because of their potential for interaction with the OCS oil and gas program.

a. Kemp's Ridley Sea Turtle

The Kemp's ridley sea turtle is the rarest of all the marine turtle species occurring in the northern Gulf of Mexico. The population has dwindled from an estimated 47,000 in 1947 to 600 nesting females today (National Research Council, 1990). The population nests, in aggregate, primarily on a 17-km stretch of beach in Rancho Nuevo, Vera Cruz, Mexico (Thompson, 1988). Nesting in the United States occurs infrequently on Padre and Mustang Islands in south Texas from May to August (Thompson, 1988). Posthatchlings appear to disperse offshore to seek refuge in sargassum mats (Collard and Ogren, 1989). They remain pelagic for about a year before returning nearshore to forage on motile forms of crustaceans. The distribution of the postpelagic life-stages is associated with the abundance of portunid crabs (Ogren, 1989). Female Kemp's ridleys appear to inhabit nearshore areas, utilizing the littoral zone along the Gulf Coast. Congregations of female Kemp's have been recorded off the mouth of the Mississippi River (Byles, 1989).

b. Loggerhead Sea Turtle

The loggerhead sea turtle occurs throughout the world and is the most common marine turtle in the United States. It has an estimated female nesting population of 5,900 (Nelson, 1988). One of the most important nesting areas in the world is in the southeast coast of the United States, from Volusia to Broward County, Florida (Brook-VanMeter, 1987). The majority of nesting in the Gulf of Mexico occurs in Florida from the Keys to Tampa Bay. However, recent surveys indicate that the Florida panhandle accounts for approximately one-third of the nesting on the Florida Gulf Coast. Loggerhead sea turtle nesting has also recently been reported on Gulf Shores and Dauphin Island, Alabama, and Ship Island, Mississippi. The

Chandeleur Islands off the Louisiana coast may be the most important nesting areas for the northern Gulf of Mexico. However, no formal nesting surveys have documented this theory. Nesting in Texas occurs primarily on North and South Padre Islands, although records are found throughout the coast. Hildebrand (1982) noted that the banks between Heald Bank and Ship Shoal (offshore Louisiana) and waters inshore of the banks and surrounding the Mississippi delta are also important marine turtle habitat. Posthatchlings appear to have a pelagic phase followed by a movement inshore and associated benthic, omnivorous feeding. As the turtles mature, their distribution is dependent on the abundance and accessibility of their benthic food.

c. Great Whales

Six endangered or threatened whale species have been reported in the Gulf of Mexico. They include one *odonticeti*--the sperm whale--and five *balaenidae*--the blue, sei, fin, Bryde's, and humpback whales.

The blue whale, averaging 24-26 m in length, is the largest animal. There are only two records of blue whale sightings in the Gulf in recent history--one off Louisiana in 1924 and another off Texas in 1940. The latter identification is questionable (Schmidly, 1981). No blue whales were sighted by Fritts et al. (1983) in 1980-1981 or by the Department of Commerce (DOC) (USDC, NMFS, 1988a) from 1983-1986. The blue whale feeds almost exclusively on krill, which inhabit temperate and arctic oceans. The feeding habits of blue whales in the Gulf are unknown.

Fin whales have been reported throughout the year in the Gulf of Mexico. Schmidly's (1981) records and sightings by the NMFS suggest that a small population inhabits the Gulf (Tucker & Associates, Inc., 1990). They are found offshore and appear to be subject to collisions with vessels (CSA, in prep.).

Humpback whales are a coastal species and feed primarily on krill and fish. Humpbacks have been sighted in the Central Gulf (in 1952 and 1957), in the Eastern Gulf near the mouth of Tampa Bay (in 1962 and 1983), and near Seahorse Key, Florida (in 1983) (Schmidly, 1981; Gainesville Sun, 1983).

Right whales are the most endangered cetacean in the Western Hemisphere (CSA, in prep.). The population in the Gulf is unknown; however, only 250-350 right whales are estimated to occur in the northwestern Atlantic Ocean. Right whales are specialized as "skimmers" that feed by swimming slowly at or just below the surface, straining concentrations of copepods. The most recent observations in the northern Gulf are two right whales reported off Brazoria County, Texas, in 1972 and off Manatee County, Florida, in 1963 (Lowery, 1974). Calving occurs off the Georgia and northeast Florida coasts (CSA, in prep.).

Sei whales feed primarily on copepods, krill, and small schooling fish. They usually travel in groups of two to five individuals. Two sei whales have been reported in the northern Gulf off Plaquemines Parish, Louisiana, in 1956 and off Gulfport, Mississippi, in 1973. No sei whales were observed in the northern Gulf during the 1980-1981 aerial surveys (Fritts et al., 1983). Valid records in the Gulf of Mexico, Caribbean, and eastern Florida suggest that there may be a resident population in the Gulf (Mead, 1977).

The great sperm whales are probably the most abundant whales in the northern Gulf. Their primary prey are on mesopelagic squid and large demersal and mesopelagic sharks, skates, and fish (Leatherwood et al., 1976). Numerous strandings and sightings of sperm whales have been reported in the Gulf for each month of the year. Sperm whales were observed by Fritts et al. (1983) and the DOC (USDC, NMFS, 1988a). These whales are more frequently sighted inn the northern Gulf of Mexico at the edge of the continental shelf or over the continental slope (Tucker & Associates, Inc., 1990).

d. Piping Plover

The piping plover is endangered in the Great Lakes watershed and threatened elsewhere. It has two distinct breeding populations--one on the Atlantic Coast and a second in the Great Plains/Great Lakes area. These populations use the beaches, sandflats, and dunes throughout the Gulf States between September and March. The largest numbers and highest wintering densities of birds were found in the Western and Central Gulf of Mexico (Nicholls, 1989). Based on sightings and the identification of feces, the preferred feeding habitats appear to be sandflats adjacent to passes and inlets, mudflats near sandy beaches, overwash sandy mudflats, and barrier beaches with overwash areas. The birds are thought to roost on secluded beaches just above the wrack line. Observations of piping plovers being impacted by spills in Texas and their preference for feeding in intertidal areas suggest their vulnerability to contact with spilled oil. The historic populations were decimated by market hunting and have remained depressed because of losses to their beach habitat. Impacts to the piping plover include the loss of beach habitat, human disturbance of nesting areas, and the loss of riverine sanbar habitat as a result of channelization and flow modifications.

e. Brown Pelican

Brown pelicans have been removed from the Federal endangered species list in Alabama and Florida but remain listed as endangered in Mississippi, Louisiana, and Texas. Their decline is primarily the result of hatching failure caused by ingestion of fish containing pesticides. Nesting occurs in colonies on coastal islands. Three brown pelican rookeries (totaling approximately 2,100 nests) occur in Louisiana--one on North Island (St. Bernard Parish), a second on Queen Bess Island (Jefferson Parish), and the third at Raccoon Point (Terrebonne Parish) (USDI, FWS, 1989). There is also a small active rookery (about 300 nesting pairs) on Pelican Island in Nueces County, Texas. Unsuccessful nesting has occurred on Sunset Island in Matagorda Bay, and 40 hatchlings have been reintroduced to San Bernard National Wildlife Refuge (USDI, FWS, 1989). Brown pelicans inhabit the coast, rarely venturing into freshwater or flying more than 32 km offshore. They feed by plunge-diving to catch fish near the surface.

f. Eskimo Curlew

The Eskimo curlew is one of the rarest native North American birds in the wild. Only 18 birds were reported between 1983-1987. Most sightings occur in coastal Texas, the largest being 23 birds from Atkinson Island, Galveston Bay, in 1981. This is the largest number reported in over 80 years. The birds migrate through and concentrate in the Gulf Coast marshes during the spring on their way from southern South America to Canada (Gollop, 1989). Eskimo curlews feed on invertebrates and crowberries in their northern range and are assumed to have similar habits along the Gulf Coast. The drastic population decline, which was first reported in the late 1800's, appears due to overharvest, habitat loss, and short-term climatic changes.

g. Whooping Crane

The whooping crane breeding population (130 individuals) winters along the Texas coast from November to April. The birds occupy the coastal marshes of Aransas, Calhoun, and Matagorda Counties during this period. Portions of these counties and all of the Aransas National Wildlife Refuge have been designated as critical habitat for the whooping crane. The birds wade in tidal flats and shallow bays, feeding primarily on blue crabs and clams (USDI, FWS, 1986). The refuge is adjacent to the Intracoastal Waterway. Sediments dredged to maintain the channel have contained hydrocarbons, and vessel traffic wave action has accelerated erosion in whooping crane critical habitat. The birds are at a high risk if hazardous materials are spilled adjacent to the refuge. Transformation of the crane's historic breeding grounds in the Great Plains by agriculture is the primary reason for its decline. A rapid recovery of the population is unlikely because of delayed sexual maturity and small clutch sizes. Natural mortality from inclement weather, predation, and fire combined with man-induced hazards such as powerlines and aircraft also inhibit the whooping crane's recovery. Changes in land use have resulted in habitat loss along the migration route and wintering areas.

h. West Indian Manatee

The West Indian manatee, a marine mammal, is an aquatic herbivore and one of five living species of the order Sirenia. It inhabits low-energy coastal areas throughout the northern Gulf of Mexico; however, it is known to winter only in south and central Florida. The cool water of the northern Gulf and the swift currents in the Straits of Florida have acted as a geographic barrier, resulting in an Antillean and Florida subspecies. The Antillean population occurs infrequently in the Central and Western Gulf of Mexico due to the species' physiological requirements for warm water. Only 11 manatees have been sighted in the Western and Central Gulf since 1975. In two of the sightings, the animals were found dead of starvation and cold stress. The two sightings in Texas are thought to be of the Antillean population coming from Mexico. The others, seven in

Louisiana and two in Mississippi, are thought to be from the Florida population (Beeler and O'Shea, 1988). The Florida population is estimated to be between 800 and 1,200 individuals (USDI, FWS, 1988a). For most of the year, they are dispersed throughout south and central Florida, often correlated with the distribution of seagrasses and vascular freshwater aquatic vegetation. During the winter, typically between November and March, manatees seek warm water by southern migration or by congregating in warm springs and industrial outfalls.

i. Gulf Sturgeon

The Gulf sturgeon--a subspecies of the Atlantic sturgeon--historically occurred in most of the major rivers, estuaries, and offshore waters of the Eastern and Central Gulf of Mexico. Today, its distribution is limited to major rivers, estuaries, and offshore waters between the Mississippi River and the Suwannee River. The healthiest population remaining in the Gulf inhabits the Suwannee River (Barkuloo, 1988). Food-habit studies suggest that the Gulf sturgeon feeds on benthic invertebrates over sand, hard-bottom, and seagrass substrates. Fish up to 3 years of age inhabit their river of origin or its estuary year-round. Thereafter, they move offshore to feed and return to the river only during the summer. During the riverine stage, adults cease feeding, undergo gonadal maturation, and migrate upstream to spawn. Spawning occurs over coarse substrate in deep holes. The decline of the Gulf sturgeon is due to overfishing and habitat destruction, primarily the damming of coastal rivers and the degradation of water quality. It will be recommended for protection as a threatened species in early 1990.

Additional information on endangered and threatened species is found in the FWS and NMFS biological opinions in Appendix B and on Visuals Nos. 2 and 2E.

4. Marine Mammals

Twenty-seven species of cetaceans, one sirenean, and one exotic pinniped have been sighted in the Northern Gulf of Mexico (Table III-6). Management of these mammals is based on the authority of the Marine Mammal Protection Act (MMPA) of 1972 (Section I.B.4.f.). The MMPA attempts to manage populations at the optimum sustainable level, which is measured by the maximum net productivity for the carrying capacity of the ecosystem. Aerial surveys by Fritts et al. (1983) and the Department of Commerce (USDC, NMFS, 1988a) found the following species: West Indian manatee, fin whale, sperm whale, short-fin pilot whale, pygmy killer whale, grampus, beaked whale (Mesoplodon species), bottlenose dolphin, striped dolphin, spinner dolphin, common dolphin, and spotted dolphin. The surveys indicated that the bottlenose dolphin was the most common marine mammal sighted. The number, distribution, and size of subpopulations in the Gulf is controversial; however, the NMFS management strategies are based on the theory that there are several distinct populations in the Gulf. Scott et al. (1989) noted that most of the bottlenose dolphins in the United States' waters of the Gulf were in water deeper than 18 m, while Gruber (1981) and Irvine et al. (1981) noted that bottlenose dolphins were particularly abundant near ship channels and seasonally near natural channels or "passes." Fritts et al. (1983) noted that the majority of bottlenose dolphin sightings occurred at depths less than 50 m. Herds of 3-7 animals, but large herds of 200-600 dolphins have been observed. Herd size may vary substantially according to depth and complexity of habitat, with larger herds usually in more open-water habitats (Wells et al., 1980). At least in some portions of the bottlenose dolphin's range, populations form relatively permanent social units that are closely tied to definable home ranges (Shane et al., 1986).

Schmidly (Tucker & Associates, Inc., 1990) expressed that strandings and surveys suggest that a significant portion of the regional population of pygmy and dwarf sperm whales, false killer whales, short-fin pilot whales, grampus, several beaked whales (Mesoplodon spp.), goosebeak whale, and several species of the genus Stenella also inhabit the northern Gulf of Mexico. Odell synthesizes distribution information in the Gulf and South Florida Atlantic coast as part of a literature review by Continental Shelf Associates, Inc. (in preparation).

Table III-6

Marine Mammals of the Northern Gulf of Mexico

Marine Mammals	Status
Cetaceans	
1. Right whale (*Eubalaena glacialis*)	1. Rare/Endangered
2. Blue whale (*Balaenoptera musculus*)	2. Rare/Endangered
3. Sei whale (*Balaenoptera borealis*)	3. Rare/Endangered
4. Fin whale (*Balaenoptera physalus*)	4. Rare/Endangered
5. Bryde's whale (*Balaenoptera edeni*)	5. Rare
6. Minke whale (*Balaenoptera acutorostrata*)	6. Rare
7. Humpback whale (*Megaptera novaeangliae*)	7. Rare/Endangered
8. Sperm whale (*Physeter macrocephalus*)	8. Common/Endangered
9. Pygmy sperm whale (*Kogia breviceps*)	9. Common
10. Dwarf sperm whale (*Kogia simus*)	10. Uncommon
11. Blainville's beaked whale (*Mesoplodon densirostris*)	11. Rare
12. Gervais beaked whale (*Mesoplodon europaeus*)	12. Uncommon
13. Sowerby's beaked whale (*Mesoplodon bidens*)	13. Extremely Rare
14. Cuvier's beaked whale (*Ziphius cavirostris*)	14. Uncommon
15. Melon-headed whale (*Peponocephala electra*)	15. Rare
16. Pygmy killer whale (*Feresa attenuata*)	16. Uncommon
17. False killer whale (*Pseudorca crassidens*)	17. Uncommon
18. Killer whale (*Orcinus orca*)	18. Rare
19. Short-finned pilot whale (*Globicephala macroryhnchus*)	19. Common
20. Rough-toothed dolphin (*Steno bredanensis*)	20. Rare
21. Common dolphin (*Delphinus delphis*)	21. Rare
22. Atlantic bottlenose dolphin (*Tursiops truncatus*)	22. Common
23. Risso's dolphin (*Grampus griseus*)	23. Uncommon
24. Atlantic spotted dolphin (*Stenella frontalis*)	24. Common
25. Striped dolphin (*Stenella coeruleoalba*)	25. Uncommon
26. Long-snouted spinner dolphin (*Stenella longirostris*)	26. Uncommon
27. Short-snouted spinner dolphin (*Stenella clymene*)	27. Uncommon
28. Pantropical spotted dolphin (*Stenella attenuata*)	28. Rare
Pinnipeds	
29. California sea lion (*Zalophus californianus*)	29. Introduced/Rare
Sireneans	
30. West Indian manatee (*Trichechus manatus*)	30. Common/Endangered

Endangered Species 50 CFR 17.11 and 17.12 (April 10, 1987).

Source: Tucker & Associates, Inc., 1990.

Marine mammals are occasionally hit by boats, shot, or harpooned (Leatherwood and Reeves, 1982). Substantial numbers of bottlenose dolphins are also captured and removed for display and scientific research or killed/injured by commercial fishing gear (Hofman, personal comm., 1990). Piscivorous marine mammals could be adversely impacted by bioaccumulation of heavy metals, hydrocarbons, and orthochlorines (Risebrough, 1978; Cummins, 1988; Martineau, 1989). The lack of bottlenose dolphins in some areas may be directly or indirectly related to such pollution (FAO-ACMRR, 1978); however, there is little evidence that oil pollution has an acute effect on marine mammals (Geraci and St. Aubin, 1988). Information on the distribution, abundance, and life history of the 24 other cetacean species is limited at best.

In 1989, MMS sponsored a workshop to discuss the state of knowledge about marine mammals in the Gulf of Mexico and to reach a concensus on future research priorities. The attendees recommended the following areas for future study: (a) assess and develop programs to detect and monitor the effects of human activities on marine mammals throughout the Gulf of Mexico; (b) determine and monitor levels of environmental contaminants and natural biotoxins in representative marine mammals in the Gulf of Mexico; (c) determine and monitor the number and species of marine mammals being caught and killed incidentally during commercial-fishing operations in the Gulf of Mexico; (d) determine and monitor the demography and dynamics of bottlenose dolphin populations in the Gulf; (e) complete the bottlenose dolphin-stock discreteness studies; (f) evaluate and improve the Gulf of Mexico marine mammal-strandings network; and (g) characterize and monitor key components of important marine mammal habitats in the Gulf of Mexico.

5. Coastal and Marine Birds

The initial and most conspicuous casualties of OCS-related oil spills are externally oiled seabirds that may drift onto shore. Those birds most susceptible to oiling either raft at sea, usually in large numbers, such as gulls and terns, or dive when disturbed, such as cormorants and boobies. Because of the strong visual impact, the death of birds associated with the coastal area from OCS-related oil and gas activities receives a heightened amount of publicity (Clapp et al., 1982a; NRC, 1985).

The beaches and wetlands of the northern Gulf of Mexico are populated by both migrant and nonmigrant species of coastal and marine birds. This broad category consists of three main groups: shorebirds, wading birds, and waterfowl. Feeding habitats include waters of the open Gulf and estuaries, as well as coastal farmlands and landfills. Reproductive activity occurs from February through August (Clapp et al., 1982a and b). Portnoy (1977) recorded 847,000 birds, representing 26 species, in habitats ranging from swamp forest to coastal marshes and barrier islands in the Central Gulf area.

The Florida Keys host several species of shore- and waterbirds; also, the Keys are an important migratory route into South America for several species of raptors and warblers. The Marquesas Islands currently support the only known nesting colony of magnificent frigate birds in North America, and the Dry Tortugas host the only known nesting colony of sooty terns in the eastern Gulf of Mexico (Runde, written comm., 1989; Spendelow and Patton, 1988).

Waterfowl consist mainly of ducks and geese. The majority of waterfowl found in the northern Gulf of Mexico coastal wetlands are overwintering migrants. The peak of the fall migration is November-December. Spring migration can begin as early as March and last through May. The major waterfowl habitats are brackish and freshwater marshes. These habitats are capable of supporting 4-7 million migratory waterfowl per season (Bellrose, 1976). The national wildlife refuges and State wildlife management areas provide important feeding and resting areas for migratory waterfowl. A few species of waterfowl are residents of the Gulf coastal area. They inhabit swamp forests and marshes in all central and western Gulf states (Portnoy, 1977; Clapp et al., 1982a and b).

Wading birds consist mainly of herons, egrets, cranes, ibis, and storks. Although their range extends to barrier islands, very few wading birds are seen offshore in the Gulf. The most abundant species are tricolor herons, snowy egrets, and cattle egrets (Fritts et al., 1983). Texas reports approximately 200,000 wading birds at 387 colony sites in their 1988 colonial waterbird census (Texas Parks and Wildlife Department, written comm., 1989). Florida west coast wading-bird colonies contained 10 species of wading and waterbirds in 1988 (Runde, written comm., 1989).

Florida's Gulf Coast colonies generally hold a large number of species of birds, and they are stable colony sites over time (Woolfenden and Screiber, 1973). For the most part, environmental conditions (water levels, prey density) around coasts are more constant than inland wetland conditions. Thus, coastal colonies may serve as reservoirs or anchors for inland wading-bird colonies that are susceptible to periodic droughts (Runde, written comm., 1989).

Shorebirds are closely associated with marine environments and consist mainly of gulls, terns, boobies, petrels, and shearwaters. With the exception of gulls, marine birds feed and roost offshore, coming ashore for nesting or when storms blow them inshore. The largest concentrations of marine birds are found near locations of high productivity; that is, upwelling areas near the continental slope edge. Aerial surveys off Marsh Island, Louisiana, and Brownsville, Texas, have determined that out of 25 and 24 species, respectively, greater than 90 percent of the marine birds were gulls and terns. Terns feed almost exclusively offshore while gulls use coastal farmlands and landfills as well (Clapp et al., 1982a and b). Texas reports approximately 300,000 shorebirds in their 1988 colonial waterbird census. Of this total number, approximately 115,000 were terns and 137,000 were gulls (Texas Parks and Wildlife Department, written comm., 1989).

6. Fish Resources

Commercial and recreational fisheries in the Gulf of Mexico are dominated by estuary-dependent species. Approximately 46 percent of the southeastern United States' wetlands and estuaries important to fisheries are located within the Gulf of Mexico (Mager and Ruebsamen, 1989). The life history of estuary-dependent species involves spawning on the continental shelf; transport of eggs, larvae, or juveniles to the estuarine nursery grounds; growth and maturation in the estuary; and migration of the young adults back to the shelf for spawning. After spawning, the adult individuals generally remain on the continental shelf. Most estuary-related species of importance--menhaden and shrimp--have short life histories of 18-36 months, but some sciaenids--croaker and red and black drum--may live for several years (Darnell, 1988).

Finfish and shellfish are sensitive to oil in varying degrees during all their lifestages (Anderson, 1985). Table III-7 details geographical distribution of lifestages for many important commercial species, including the two most important species in the Gulf of Mexico--menhaden and shrimp. Although they are both considered continental shelf species, they are estuary dependent. This means that spawning times and places are synchronized with hydrography such that eggs, larvae, and young arrive at estuary nursery areas during the appropriate season. Menhaden spawn near the water surface in a localized area of the middle continental shelf proximate to the Mississippi River Delta during the winter and early spring. During late spring, young menhaden enter the nursery areas from the delta region to as far west as Galveston Bay. The two major shrimp species--brown and white--spawn in a widely distributed area of the middle continental shelf during nonoverlapping short periods in spring and summer. Their larvae become dispersed throughout the water column and along a broad east-west band on the inner shelf before tides, currents, and wind bring the postlarvae into estuary nursery areas in early spring. In this manner, brown and white shrimp use extensive nursery areas from the west coast of Florida to the east coast of Mexico.

Darnell et al. (1983) and Darnell and Kleypas (1987) found that the density distribution of total fish and penaeid shrimp catch in the northwestern Gulf was highest nearshore off Louisiana. For all seasons, the greatest abundance of fish and penaeids occurred between Galveston Bay and the Mississippi River. This may be directly attributable to the extensive estuary-nursery areas of Louisiana. The density distribution of total fish catch for the Eastern Gulf was patchy. High densities were associated with particular habitat types (e.g., east Mississippi Delta area, Florida Big Bend seagrass beds, nearshore areas off the Everglades, southwest Florida mid/outer shelf, and the DeSoto Canyon area). In addition, estuaries of the Central and Western Gulf are known to export considerable quantities of organic material, thereby enriching the adjacent continental shelf areas (Darnell and Soniat, 1979).

Approximately 30 percent of the other numerically significant fish species from the continental shelf are also estuary dependent. Low-salinity estuaries are dominated by oysters, crabs, sciaenids, anchovies, and mullets. Populations from the inshore-shelf zone (7-14 m) are dominated seasonally by Atlantic croaker, spot, drum, silver seatrout, southern kingfish, and Atlantic threadfin. Populations from the middle-shelf zone (27-46 m) include sciaenids but are dominated by longspine porgies. The blackfin searobin, Mexican searobin, and

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Table III-7

Species Descriptions - Economically Most Important Commercial Fisheries Species of the Gulf of Mexico, 1985

Species	Adult	Eggs	Larvae	Postlarvae	Juveniles	Fishery
Pink Shrimp *(Penaeus duorarum)*	Habitat - benthic - depth: shore to 65 m - substrate: firm sand, shell/ sand, coral - salinity: 20 ppt and higher Feeding Habits - omnivorous; feed on detritus and algae; prey on polychaetes, nematodes, caridean shrimp, mysids, and copepods - nocturnal: feed at night or during day when weather is overcast or water is turbid Reproduction - sexual maturity is reached in about 1 year - spawning occurs offshore (12-26 fathoms) - southern Florida: spawning occurs year-round, peaking from spring to fall - northern Florida: summer is most active period for spawning	demersal	- pelagic; develop offshore - feed on plankton and detritus	- migrate to nursery (bays, estuaries): Big Bend Seagrass beds in northern Florida, Florida Bay grass beds in southern Florida - feed at night; scavenge on bottom and feed on suspended detritus	- nursery is in estuaries (seagrass beds) where they remain for 2-6 months until mature; found in nursery year-round in southern Florida and in summer and fall in northern Florida - omnivorous; feed on detritus, algae, and microfauna	- gear: trawls - majority of pink shrimp are caught at depths of 20-27 m; caught at night or on overcast days - the two major fishing grounds are the Tortugas in the Keys and Sanibel off Lee County - largest catch is from January-May
Groupers & Scamp Red Grouper *(Epinephelus morio)* Gag Grouper *(Mycteroperca microlepis)* Scamp *(Mycteroperca phenax)*	Habitat - demersal reef fish - depth: 30-120 m - favor vertical relief areas, e.g., wrecks, artificial and coral reefs, rocky areas, holes, and ledges - red and gag grouper found more nearshore; scamp is more common offshore Feeding Habits - carnivorous; feed on fish, crustaceans, and molluscs found on or near bottom Reproduction - spawning occurs over the continental shelf: - red grouper: occurs at depths of 25-90 m, March - July - gag grouper: January-March - scamp: March-April; Florida Middle Ground is an important spawning ground	- pelagic; bouyant - stage = 4 days	- planktonic - stage = 3-4 weeks	- transition stage: planktonic to demersal	- nursery: grass beds, rock formations, and shallow reef areas	- gear: hook and line - harvested in offshore waters

Table III-7. Species Descriptions - Economically Most Important Commercial Fisheries Species of the Gulf of Mexico, 1985 (continued)

Species	Adult	Eggs	Larvae	Postlarvae	Juveniles	Fishery
Spiny Lobster *(Panulirus argus)*	Habitat - benthic - depth: 10-80 m or more - substrate: reefs and rubble; inhabit crevices, dens, overhangs, ledges, and rocky outcroppings where reside individually or communally - temperature: 18°-31°C - salinity: 19 ppt and above Feeding Habits - opportunistic omnivore; feed on molluscs, small crustaceans, algae, worms, sponges, and carrion - forage for food at night flats, and algae assemblages Reproduction - sexual maturity attained at 3+ years of age - mating occurs from March-July - spawning occurs in offshore waters along deeper reef fringes from April-October	- carried by female for 3-4 weeks	- pelagic; develop offshore for 8-9 months - undergo diel pattern of vertical distribution; surface at night and descend during day - carnivores; feed on zooplankton	- migrate inshore to seagrass or mangrove nursery, primarily during the new and first-quarter lunar phases - nonfeeding stage	- habitat is mangroves and seagrass beds; spend 1.5 years in nursery; critical habitat for early juveniles is macroalgae communities, particularly those dominated by the red alga, *Laurencia*, which occurs in shallow water along rocky shorelines - principal nursery for south Florida is Florida Bay and Biscayne Bay - opportunistic omnivores; forage at night - young juveniles are solitary	- location: south Florida, principally Monroe County - gear: traps - season: 25 July 31 March - sanctuary is Everglades National Park, Fort Jefferson National Monument, Dry Tortugas, and Biscayne Bay/ Card Sound
Stone Crab *(Menippe mercenaria)*	Habitat - benthic; burrow in soft substrate in or near seagrass beds or live in rock crevaces or wrecks - depth: shore to 54 m Feeding Habits - primarily carnivorous but may be herbivorous; feed on molluscs, crustaceans, worms, seagrasses, and carrion nocturnally Reproduction - attain sexual maturity in 1 year - spawning occurs year-round in Florida Bay, but in more northern areas, it occurs from March-October; peak spawning occurs in May and September; stone crabs migrate offshore to spawn	- carried as a sponge by female for 4-6 weeks	- planktonic; undergo 2-4 week development period offshore - feed on zooplankton	- benthic	Habitat - seagrass beds, sponges, soft corals, and *Sargassum* mats in estuaries; also use shell and rocky substrates; juveniles do not burrow - principal nursery areas: Florida Bay and Ten Thousand Islands Feeding - opportunistic carnivores	- gear: traps - principal fishery is off Collier County in northern Florida Bay; harvested from Tampa Bay to the Florida Keys and in Apalachee Bay - fishing occurs in coastal waters to a depth of 18 m - season: 18 October-15 May

Table III-7. Species Descriptions - Economically Most Important Commercial Fisheries Species of the Gulf of Mexico, 1985 (continued)

Species	Adult	Eggs	Larvae	Postlarvae	Juveniles	Fishery
Oyster *(Crassostrea virginica)*	Habitat - sedentary; live in clusters called reefs or beds; found in large estuarine bays and sounds and on offshore sandy bars - substrate: firm, stable shell material or mud/sand/shell bottoms or other hard substrates - depth: less than 10 m - salinity: euryhaline, 5-35 ppt, optimal range 10-22 ppt - temperature: can withstand a wide range - current: moderate currents required to supply food, remove wastes, and transport gametes Feeding Habits - filter-feeder. food primarily consists of diatoms, flagellates, bacteria and detritus Reproduction - sexually mature within 4 weeks of attachment - spawning is stimulated by changes in water temperature; in the Gulf it occurs at 25°C when the temperature has been consistently above 20°C; occurs from March-November with peaks in June and September	- demersal; stage lasting 5-9 hours	- meroplanktonic lasting 2 weeks - feed on phytoplankton	N/A	- larvae settle and attach to clean cultch (shell) material and are called spat - seed oysters are juveniles 26-75 mm in in height and 7-14 months old	- commercial fishing seasons are regulated by State as follows: May Alabama: year-round unless closed by health department Mississippi: September-April (staggered openings) Louisiana: September-April (staggered openings) Texas: November-April - harvested by hand, tonging, and dredging
Black or Striped Mullet *(Mugil cephalus)*	Habitat - demersal; found in muddy bottom estuaries, brackish water lagoons, freshwater rivers, and offshore on the continental shelf - euryhaline and eurythermal Feeding Habits - herbivorous; feed on algae, diatoms, and organic detritus by sucking up surface layers of muddy bottoms or grazing on seagrass, rocks, or other surfaces Reproduction - sexually mature in 2-3 years - form large schools and migrate offshore from October-April to spawn; peak spawning period is late November-December; spawn from shore to 40 m depth	- pelagic; floating; hatch within 2 days	- planktonic - feed on zooplankton - stage last 20-24 days - transported via currents to estuaries	- enter nursery in estuaries and shallow nearshore waters from November-March - travel in small schools near the shore	- remain in estuaries until sexually mature - herbivores	- gear: gill net - caught in estuaries and coastal areas - season: September-December

Table III-7. Species Descriptions - Economically Most Important Commercial Fisheries Species of the Gulf of Mexico, 1985 (continued)

Species	Adult	Eggs	Larvae	Postlarvae	Juveniles	Fishery
Red Snapper *(Lutjanus campechanus)*	Habitat - demersal - found on sandy and rocky bottoms, around reefs and underwater objects - depth: 40-200 m Feeding Habits - carnivores - feed along the bottom on fishes, tunicates, crustaceans, and molluscs Reproduction - sexual maturity reached in 2+ years - spawning: specific location unknown; spawn in offshore waters from late June-October	- pelagic; buoyant - stage = 4 days	- planktonic; found in coastal and estuarine waters - stage = 3-4 weeks	- transition stage: planktonic to demersal	- nursery is coastal and estuarine waters with mud and sand bottoms where the depth is less than 40 m - feed on zooplankton, small fish, crustaceans, and molluscs	- gear: hook and line - season: year-round - harvested in deep offshore waters
Brown Shrimp *(Penacus aztecus)*	Habitat - benthic - depth: shore to 110 m; highest densities found between 27 and 55 m - salinity: above 20 ppt - substrate: mud, sandy mud bottoms Feeding Habitats - omnivorous predators - feed at night on detritus, algae, benthic polychaetes, amphipods, and nematodes Reproduction - reach sexual maturity within a year - spawn year-round with peak periods during October-December and March-May; spawns at depths greater than 14 m, but mostly between 27-110 m	- demersal	- pelagic; feed on plankton and suspended detritus	- become demersal after moving into estuary; feed on detritus and algae	- benthic - occurs on mud/sand bottoms and in seagrass beds in estuaries - omnivores; feed on organic detritus and fecal pellets	- gear trawls - major fishing grounds are off coasts of Texas and Louisiana between depths of 20-90 m; harvested at night - seasons: spring, summer, and fall - largest catch is from June-October

Table III-7. Species Descriptions - Economically Most Important Commercial Fisheries Species of the Gulf of Mexico, 1985 (continued)

Species	Adult	Eggs	Larvae	Postlarvae	Juveniles	Fishery
White Shrimp *(Penaeus setiferus)*	Habitat - benthic - substrate: mud or clay bottoms - depth: less than 35 m highest densities found at 18 m or less - salinity: euryhaline - temperature: eurythermal Feeding Habitats - omnivorous; feed on detritus, algae, benthic polychaetes, molluscs, crustaceans, and zooplankton; more predatory at larger sizes; feed usually during day Reproduction - sexual maturity reached within one year in offshore waters - spawn from March-September (peak months are June and July) in offshore waters at depths 8-31 m and temperatures between 21°-30°C	- demersal	- planktonic; develop in offshore waters; feed on plankton and detritus; stage lasts 10 or more days	- planktonic; migrate into estuaries from June-September and become benthic; migrate farther into estuary than brown shrimp; prefer salinities of 10 ppt or less; feed on detritus and scavenge on bottom sediments	- nursery: estuaries - benthic; prefer mud or peat bottoms with vegetation - omnivorous; prefer fecal pellets	- gear: trawls - caught during daylight in waters less than 27 m in depth (mostly in waters less than 14 m); major fishing grounds from central Texas to Apalachicola, Florida, with most effort concentrated off Louisiana - season: spring, summer, and fall - largest catch is from October-January
Gulf Menhaden *(Brevoortia patronus)*	Habitat - pelagic - soft substrate preferred - found in estuarine and shelf waters to a maximum depth of 120 m; spring and summer - congregate (school) in shallow water near shoreline (depths <18 m) in low salinity waters (5-15 ppt); fall and winter-move offshore to warmer higher salinity waters (> 30 ppt) Feeding Habits - omnivorous filter feeders; feed on phytoplankton, zooplankton, detritus, and bacteria Reproduction - sexual maturity is reached in the second year of life - spawn from October-March (peak is during winter months) mostly in open Gulf waters less than 18 m in depth; intermittent spawners (spawn 4-5 times per season)	- pelagic; buoyant - hatch within 48 hours - require high salinity water (25-32 ppt) - temperature requirement: 10°-26°C	- planktonic; feed on pelagic zooplankton - passively transported into estuaries by currents from September-April - low salinities are thought to be required for development	N/A	- first-year juveniles are found in shallow estuarine areas (Salinity =5-10 ppt) - older juveniles migrate in schools to deeper, more saline waters of bays, sounds, and nearshore waters - temperature: 5°-34°C - dissolved oxygen must be >3 ppm - omnivorous filter-feeders	- gear: purse sein - harvested offshore within 3 miles of coast - season: April - mid-October - fishing grounds extend from Matagorda Bay, Texas, to Apalachicola Bay, Florida

Table III-7. Species Descriptions - Economically Most Important Commercial Fisheries Species of the Gulf of Mexico, 1985 (continued)

Species	Adult	Eggs	Larvae	Postlarvae	Juveniles	Fishery
Blue Crab *(Callinectes sapidus)*	Habitat - benthic; found in estuaries and in nearshore waters to a depth of about 90 m (most are found at depths less than 35 m) - substrate: muddy and sandy bottoms with aquatic vegetation - adult males prefer low salinity waters - adult females prefer higher salinities of the lower estuary and nearshore waters Feeding Habits - opportunistic omnivore; feeds on annelids, molluscs, crustaceans, carrion, and detritus; can be cannibalistic Reproduction - sexually mature in 1-1.5 years - mating occurs from March-November; females migrate to brackish waters of upper estuary to mate - females move to higher salinity waters in lower estuary and nearshore waters to spawn; spawning occurs within 2 months of mating in the spring and summer and the following spring if mating occurs in fall - spawning occurs year-round in warmer waters of southern Texas and southern Florida	- carried by female as a sponge - hatch in 2 weeks	Zoeae - develop offshore and travel great distances via currents; zoeae are filter-feeders; stage is 31-49 days in length; they are distributed throughout the water column	Megalopae - migrate into estauries during late summer, early fall; omnivorous feeders when become benthic; stage is 6-20 days in length	- found in middle to upper estuarine waters on soft, mud bottoms, near marshes - omnivores; feed on molluscs, crustaceans, fish, vegetation, and detritus	- gear: primarily crab pots; also trawls and trotlines - season: March-fall; greatest catch May-August (peak June-July) - harvested in estuaries

Sources:
Bryan et al., 1982.
Christmas and Waller, 1975.
Christmas et al., 1982.
Florida Sea Grant Program, 1976a and 1976b.
Ladner and Franks, 1984.
Marx and Herrnkind, 1986.
Muncy, 1984.
Palik and Kunneke, 1984.
Perret et al., 1980.
Perry and McIlwain, 1986.
Perry et al., 1984.
Renfro and Brusher, 1982.
Stanley and Sellers, 1986.
Turner and Brody, 1983.
USDC, NMFS, 1986.
USDC, NOAA, 1985.
USDI, FWS, 1982.
USDI, FWS/MMS, 1984.

shoal flounder are dominant on the outer-shelf zone (64-110 m). Natural reefs and banks, located mainly between the middle- and outer-shelf zones, and the numerous offshore platforms acting as artificial reefs support such fishes as snappers, groupers, mackerels, and seabass. Oceanic fish such as tuna and swordfish inhabit deep ocean waters south of the Central and Western Gulf area.

A total of nine species of penaeid shrimp contribute to the Gulf of Mexico commercial shrimp fishery. Brown, white, pink, royal red, and rock shrimp constitute the bulk of the harvest. Brown shrimp are centered in the northwestern Gulf. Although white shrimp occur in all planning areas of the Gulf, they are centered on the mud and sand bottoms in the Central Gulf. Royal red shrimp are located in the deep waters of the Mississippi and DeSoto Canyons. Pink shrimp have an almost continuous distribution throughout the Gulf, but most commercial catches of pink and rock shrimp are made on the shell, coral sand, and coral silt bottoms off southern Florida. See Visuals Nos. 2 and 2E for major finfish- and shellfish-harvesting areas.

Gulf menhaden occur in the inshore waters of the northcentral Gulf from eastern Florida to eastern Texas, with approximately 93 percent of the harvest occurring within 16 km of shore. The industrial bottom fishery also occurs in the nearshore waters of the northcentral Gulf, taking advantage of the seemingly inexhaustible numbers of sciaenids. Atlantic croaker constitutes the largest component of the catch, which includes spot, sand seatrout, silver seatrout, cutlass fish, sea catfish, and longspine porgy.

Recent data analysis indicates a major change in the characteristics of the finfishery during the interval from 1981 through 1987. The number of commercial species landed from the Gulf of Mexico increased significantly, from 27 in 1981 to 82 in 1987. In addition, the number of species with a value over $1 million has tripled from three in 1981 to nine in 1987 (Linton, 1988; USDC, NMFS, 1989a). Some of the more valuable species include snapper, grouper, mackerel, black drum, spotted and silver seatrout, pompano, yellowfin and bluefin tuna, shark, swordfish, amberjack, and sheepshead. The majority of this catch is harvested from the northcentral and northwestern Gulf, where hard substrate aided by numerous offshore petroleum platforms is thought to be a positive contributing factor for several species (Linton, 1988).

Central Gulf of Mexico

Virtually all the important species in Alabama, whether shellfish or finfish, are estuary dependent. Alabama's dominant commercial catches are shellfish (shrimp, crab, and oyster). The oyster fishery is supported by 1,241 ha of public reefs located mainly in the southern half of Mobile Bay. Shrimping is the most significant fishery in Alabama. Brown, white, and pink shrimp are the predominant species caught, with brown and white shrimp contributing the most to the harvest. The important commercial finfish include Atlantic sheepshead, red snapper, and black mullet. Commercial-fish landings in Alabama during 1988 were 15.7 million pounds valued at $38.5 million (USDC, NMFS, 1989a).

The high productivity of the Mississippi Sound estuarine system, about 175,365 ha, produces large quantities of finfish and shellfish harvested by Mississippi. This system includes all coastal waters of Mississippi and is bounded on the west by Lake Borgne, on the east by Mobile Bay, on the south by the Mississippi barrier islands, and on the north by the extent of tidal influence into the riverine region (Mississippi Bureau of Marine Resources, 1981). Approximately 2,025 ha of State-managed public oyster beds are located throughout the Sound. Brown, white, and pink shrimp are the predominant shrimp species caught. Brown and white shrimp contribute the most to the harvest and are the most important harvest in Mississippi in terms of both quantity and value. Menhaden is the most valuable finfish landed while Atlantic croaker, spot, and sand seatrout are harvested by the industrial bottomfish fishery. Bottomfish, such as croaker and catfish, are harvested from waters of the middle shelf and support a coastal pet food industry. The important commercial finfish include red snapper, black mullet, and yellowfin tuna. Commercial-fish landings in Mississippi during 1988 were 290 million pounds valued at $43.7 million (USDC, NMFS, 1989a).

Louisiana is the most productive state in the Gulf of Mexico in terms of commercial fisheries because of its extensive estuaries, coastal marshes, and nutrient input from the Mississippi and Atchafalaya Rivers (Grimes, 1988). Coastal Louisiana contains approximately 60 percent of the estuaries and marshes in the Gulf of Mexico. Over 90 percent of the blue crab harvest, which amounts to about 50 million pounds, comes from estuary-nursery areas. Shrimp constitutes the most valuable fishery, with highly variable landings that depend on environmental conditions in the estuaries during postlarval development. Commercial production is generally good with an early and relatively dry spring (Barrett and Ralph, 1976). Menhaden constitutes the greatest amount landed in Louisiana and is supported by an extensive nearshore fleet and three ports that specialize in the landing of menhaden. Nearly 8,100 ha of oyster reefs are managed by the State as oyster seed-ground reservations. There are about 94,770 ha of private oyster leases in Louisiana and 279,450 ha of public oyster grounds. However, over the past 50 years, Louisiana oyster grounds have been increasingly impacted by the loss of wetlands and subsequent saltwater intrusion. More recently, the harvest of oysters has been limited by contamination from fecal coliforms (Dugas, 1988). The important commercial finfish include red snapper, spotted seatrout, black drum, vermillion snapper, yellowfin and bluefin tuna, shark, black mullet, and swordfish. Commercial-fish landings in Louisiana during 1988 were 1.4 billion pounds valued at $316.5 million (USDC, NMFS, 1989a).

Western Gulf of Mexico

Approximately 620,460 ha of estuaries play a dominant role in the production of commercial fisheries in the coastal areas of Texas (Diener, 1975). Shrimps, oysters, blue crabs, and numerous finfish constitute the principal fisheries. In recent years, shrimp (brown and white) have consistently accounted for 75 percent of the landings and 95 percent of the landings value for Texas (Restrepo and Associates, 1982). Hofstetter and Ray (1988) report that nearly 80 percent of the oyster production in Texas comes from the Galveston Bay system. However, over the past decade, Texas oyster grounds have been adversely affected by conditions of hypersalinity, or the harvest of oysters has been limited by contamination from fecal coliforms (Hofstetter, 1988; Quast et al., 1988). The important commercial finfish include yellowfin tuna, red snapper, spotted seatrout, black drum, and cobia. Commercial fish-landings in Texas during 1988 were 67.8 million pounds valued at $182 million (USDC, NMFS, 1989a).

Eastern Gulf of Mexico

Important invertebrates landed on Florida's west coast include the American oyster, spiny lobster, blue crab, stone crab, and six species of shrimp (pink, white, brown, seabob, royal red, and rock). Most of the oysters are harvested from the Apalachicola Bay oyster beds; the remainder (about 3%) are primarily produced in Bay and Gulf Counties. Most of the spiny lobster landings are from Monroe County. Spiny lobster harvest is prohibited in the parts of Florida Bay within the Everglades National Park. This area serves as an important nursery ground for lobster stocks that will enter the fishery. Other areas within Florida Bay, particularly depths less than 4 m, also provide extremely important habitat for juveniles recruited from Caribbean stock destined to enter the Florida fishery.

Most of Florida's west coast blue crab landings (about 90%) are from the estuarine or nearshore coastal waters from Franklin to Pasco Counties; however, considerable fisheries also exist in the area from Escambia to Gulf Counties, Pinellas to Lee Counties, and Collier to Dade Counties. The principal fisheries for stone crabs are off Collier County and in northern Florida Bay. The Tortugas Grounds west of Florida Bay contribute up to 50 percent of the Florida west coast pink shrimp catch. Florida Bay shallows and adjacent shelf areas are vital nursery grounds for the Tortugas shrimp fishery. In 1981, the Tortugas Shrimp Sanctuary was established to protect this area (Visual No. 2E) by prohibiting shrimp trawling (Florida Dept. of Natural Resources, 1981). Due to the very poor pink shrimp catch off the west coast in 1988, this sanctuary was opened to shrimp trawling for approximately 90 days in the fall of 1988.

The Sanibel Grounds off Charlotte and Lee Counties and Tampa Bay produce about 28 percent of the pink shrimp catch. Other important nursery areas for pink shrimp include the Charlotte Harbor-Pine Island Sound and Tampa Bay estuarine systems, the vast Big Bend seagrass beds, and the Apalachicola Bay and Pensacola Bay systems. Most white and brown shrimp are harvested in the offshore area from Escambia to Gulf Counties. Adult rock shrimp harvests occur in the offshore Florida area from Walton to Franklin Counties, generally in 27-55-m depths. Unlike pink, white, and brown shrimp, rock shrimp are not vitally dependent upon brackish estuaries for nursery support. Rock shrimp juveniles generally occur near the shallow perimeter of adult grounds or immediately shoreward of them; however, high-salinity portions of estuaries may be used when adult grounds occur only short distances away. Seaward parts of Apalachicola Bay and St. Andrew Bay provide some nursery habitat for the Cape San Blas adult grounds (State of Florida Marine Fisheries Commission, written comm., 1989).

Coastal fishes of economic importance to western Florida include amberjack, cobia, Atlantic sheepshead, black drum, spotted seatrout, menhaden, whiting, pompano, bonefish, snook, and black mullet. Most of these commercial species occur along the entire Florida Gulf Coast. However, fishes such as menhaden are temperate and subtropical forms and are found mainly in the northern Gulf; others, such as snook and bonefish, are tropical and are found mainly in southern Florida (State of Florida Marine Fisheries Commission, written comm., 1989).

The greatest contribution of reef fishes to Florida's west coast landings comes from four species of groupers (red, jewfish, gag, and scamp) and five species of snappers (red, mangrove, lane, vermilion, and yellowtail). These species are found in prominent reef areas such as the Florida Middle Ground and occur on the continental shelf wherever hard/live bottoms with rocks, holes, or crevices are available (State of Florida Marine Fisheries Commission, written comm., 1989).

Pelagic fishes make seasonal migrations up and/or down the west coast of Florida. In spring, king and Spanish mackerels leave their wintering areas in South Florida and move northward along the continental shelf to their spawning and summering areas in the northern Gulf. Both species spawn over the continental shelf from northwestern Florida to the northwestern Gulf off Texas. Their nursery area is probably the shallow portion of the shelf at the high nutrient areas near river plumes (Grimes, 1988). Yellowfin and bluefin tuna are mainly found beyond the continental shelf during winter and spring, but after spawning they move through the Florida Straits into the Atlantic Ocean. Billfishes (black marlin, white marlin, sailfish, and swordfish) spawn off northwestern Florida, mostly in areas beyond the continental shelf (State of Florida Marine Fisheries Commission, written comm., 1988).

Other important pelagic species that migrate and spawn at varying distances along the Florida west coast include little tunny, blackfin tuna, dolphin fish, wahoo, and bluefish. Commercial-fish landings for the west coast of Florida during 1988 were 143 million pounds valued at $131.4 million (USDC, NMFS, 1989a).

C. OTHER RELEVANT ACTIVITIES AND RESOURCES

1. OCS Oil and Gas Industry

The infrastructure for oil and gas production in the Gulf of Mexico is the most developed in the world. It includes oil refineries, petrochemical and gas processing plants, supply bases for offshore services, platform-construction yards, pipeline yards, and other industry-related installations. This infrastructure is highly concentrated in the coastal areas of Louisiana and eastern Texas and, to a lesser extent, along the southern half of the Texas Gulf Coast and east of Louisiana as far as Mobile, Alabama. Visual No. 1 provides a graphic display of the extent and concentration of the Gulf region infrastructure with tabulation on the back of the visual.

The Gulf of Mexico offshore oil and gas industry has experienced dramatic changes over recent years. Figures III-9 through III-11 illustrate the trends in Federal offshore mobile-rig utilization, leased Federal OCS acreage, and U.S. hydrocarbon wellhead prices, respectively. These graphs, which cover the period from 1974 through half of 1989, clearly indicate the volatility of the offshore industry since 1981.

In Figure III-9, Mobile Rig Utilization, the supply curve represents the total number of mobile drilling rigs available in the Gulf of Mexico. The demand curve represents only those rigs working in Federal OCS waters (or the supply less the number of rigs that are stacked or in shipyards). Federal offshore mobile-rig demand decreased significantly between the end of 1981 and mid-1983. In the midst of this decline, however, industry continued to expand its capacity in response to earlier years of growth. This is illustrated by the supply curve in Figure III-9, which remained fairly stable even though the demand for mobile rigs decreased.

The institution of the areawide Federal offshore leasing program in mid-1983 provided a significant boost to the declining oil and gas industry. The total amount of leased OCS acreage jumped from 11.7 million acres (4.7 million ha) in the second quarter of 1983 to 19 million acres (7.7 million ha) in the fourth quarter of 1984 (Figure III-10). Offshore-rig utilization increased dramatically from mid-1983 through the fourth quarter of 1984.

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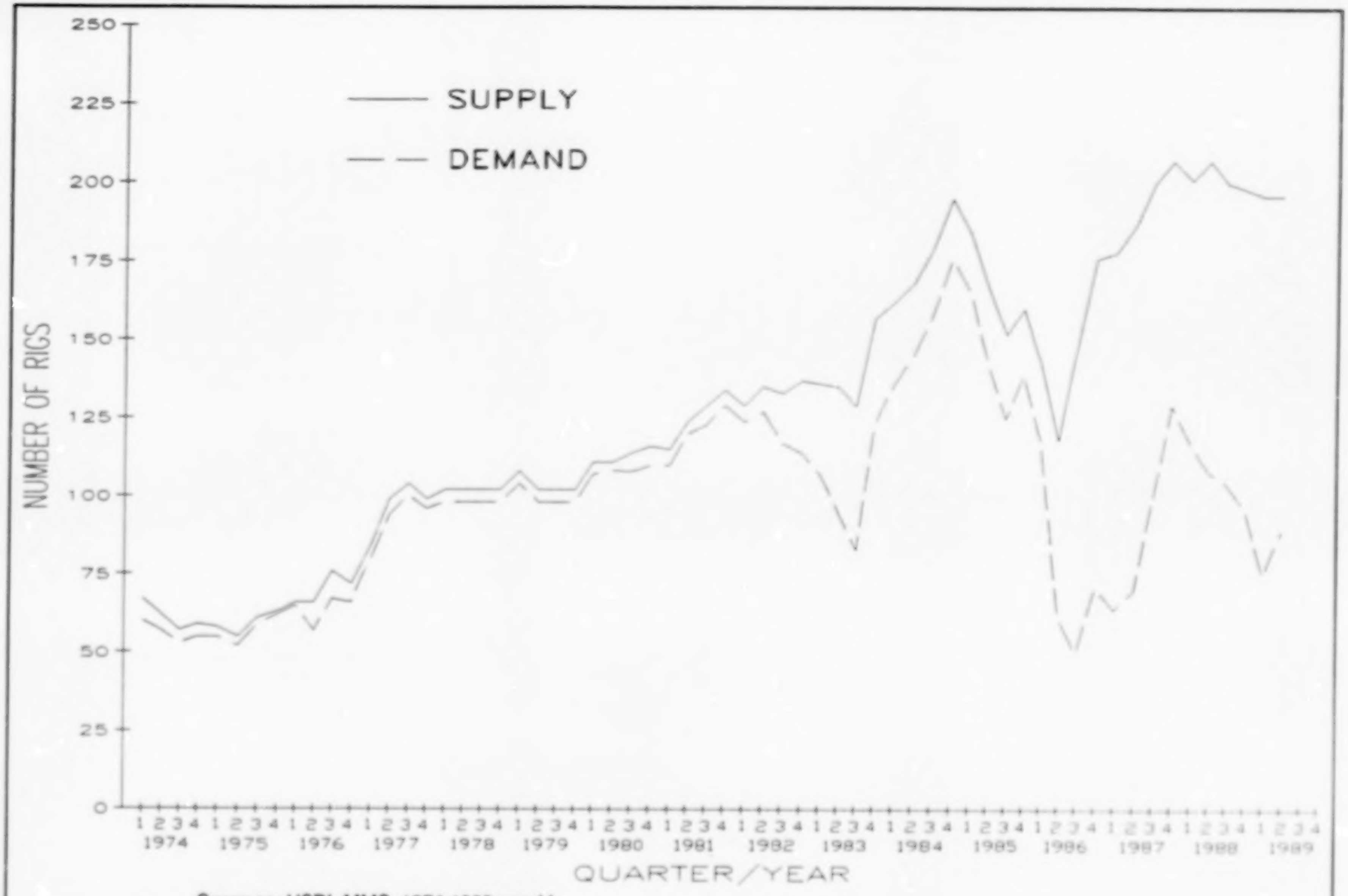

Sources: USDI, MMS, 1974-1989a and b.

Figure III-9. Supply and Demand for Mobile Rigs in the Gulf of Mexico OCS Region from 1974 to 1989.

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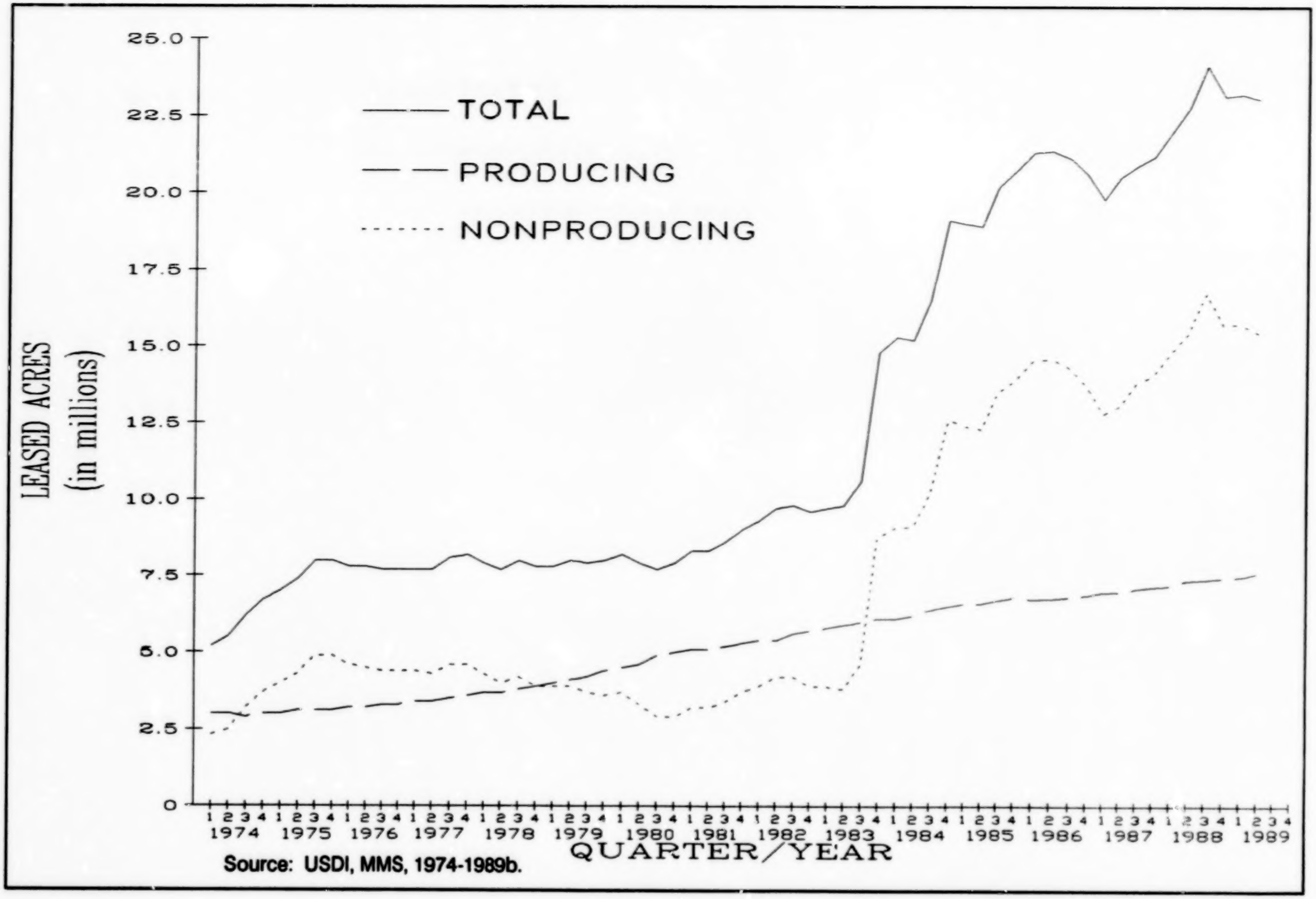
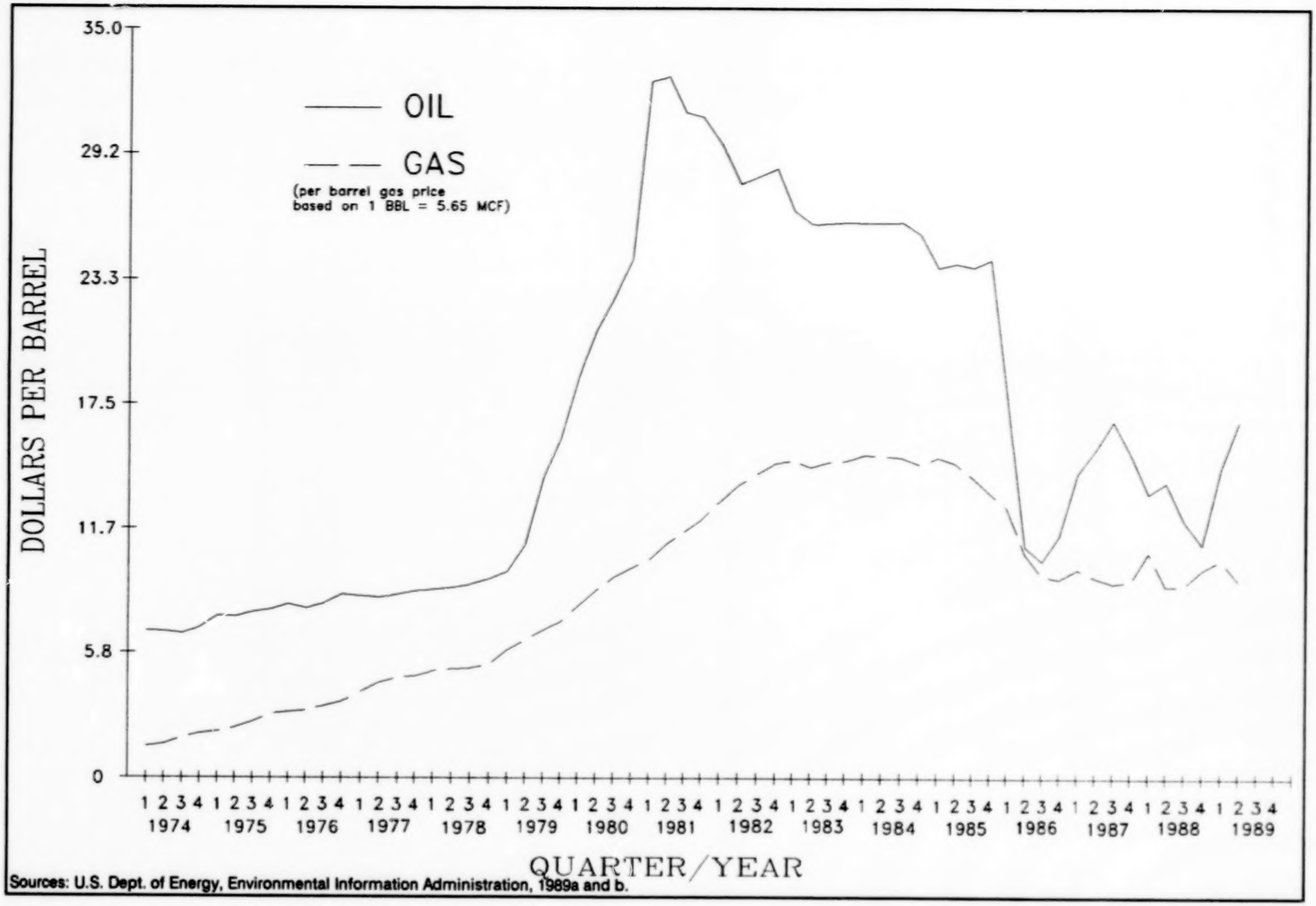


Source: USDI, MMS, 1974-1989b.

Figure III-10. Producing, Nonproducing, and Total Acreage Leased in the Federal Waters of the Gulf of Mexico from 1974 to 1989.



Sources: U.S. Dept. of Energy, Environmental Information Administration, 1989a and b.

Figure III-11. Oil and Gas Wellhead Prices from 1974 to 1989.

By the first quarter of 1985, the recognition of a continued excess supply of oil and gas worldwide halted the growth of offshore drilling activity in the Gulf of Mexico. Wellhead prices of oil and gas showed a declining trend throughout 1985 before plummeting to approximately 50 percent of the 1985 year-end prices by the second quarter of 1986. Despite continued offshore Federal areawide lease sales in the Gulf of Mexico, offshore drilling decreased drastically throughout 1985 and 1986. The latter quarters of 1987 and early 1988 saw a steady increase in the demand for mobile rigs concurrent with the slight upward trend in prices at that time and the continuation of areawide leasing. However, offshore mobile-rig utilization in the first two quarters of 1989 has once again declined to early 1987 levels. This decline is primarily attributed to a recent reduction in the wellhead price of oil.

Although there have been fluctuations in mobile rig utilization and hydrocarbon-wellhead prices (Figures III-9 and III-11), producing leased OCS acreage has increased steadily since 1974 (Figure III-10). As of May 1989, a total of 23.0 million acres (9.3 million ha) were under lease; and, of this total, 7.6 million acres (3.1 million ha) were producing.

In summary, the current situation is an offshore sector that has a significant idle capacity of equipment and labor. This idle capacity and the low levels of drilling are expected to continue until the wellhead price of oil and gas stabilizes at a higher level.

Figures III-12 and III-13 graphically illustrate the production and production value of oil and natural gas in Louisiana and Texas. It is interesting to note that oil and condensate production peaked in 1972 at 389.3 million bbl, while the production value of oil and condensate reached its highest level, $10.2 billion, in 1984. Oil and condensate production actually decreased during the period from 1972 to 1980, while the production value increased during that same period. From 1980 to 1985, production increased steadily; from 1985 to 1988, the production value stabilized somewhat and then decreased. Natural gas production in Louisiana and Texas reached its highest level in 1981 at 4,836.8 bcf. The production value of natural gas peaked in 1984 at $12.7 billion. The value of gas production declined from 1985 through 1988; the volume fluctuated during that timeframe.

In relation to the MMS offshore leasing program, the exploration and production of crude oil and gas is classified as a primary industry. Classified as secondary industries are the processing activities associated with processing crude oil and gas in refineries, natural gas plants, and petrochemical plants. While detailed employment information strictly related to offshore activity in the Gulf of Mexico is not readily available, data for selected Standard Industrial Classification (SIC) codes from the annual U.S. Bureau of the Census' *County Business Patterns* can be used to estimate such employment and related economic effects on the coastal region. The issue of *County Business Patterns* published in August 1988 contains 1986 data. The results of the most recent MMS Gulf of Mexico OCS Region offshore-employment analysis are discussed in the following paragraph. The specific SIC codes used in the analysis include the following:

13 - oil and gas extraction
29 - petroleum and coal products
3533 - oil field machinery
46 - petroleum pipelines
492 - gas production distribution
517 - petroleum and petroleum products

These SIC codes can be used to further identify the extent of direct and indirect employment in the oil and gas industry. SIC 13, which is the code that includes crude oil and gas production, is the primary industry from which direct-employment estimates are obtained. The other codes listed identify secondary industries that form the base for estimating indirect employment. Excluded from this analysis are some SIC codes that include OCS-related industries within broader categories of data (i.e., SIC 3731 includes shipbuilding and mobile rig fabrication). Finally, numerous tertiary industries are not shown above but are affected by both direct and secondary industry employment. Such tertiary industry activity, however, is included in the MMS employment analysis.

The OCS oil and gas production, particularly offshore Louisiana, has been a major source of revenue in the study area since 1954. Based on the 1986 Census data, the average annual payroll associated with oil and gas activities amounts to approximately $1.7 billion for the Gulf Coast region ($1.2 billion for the Central

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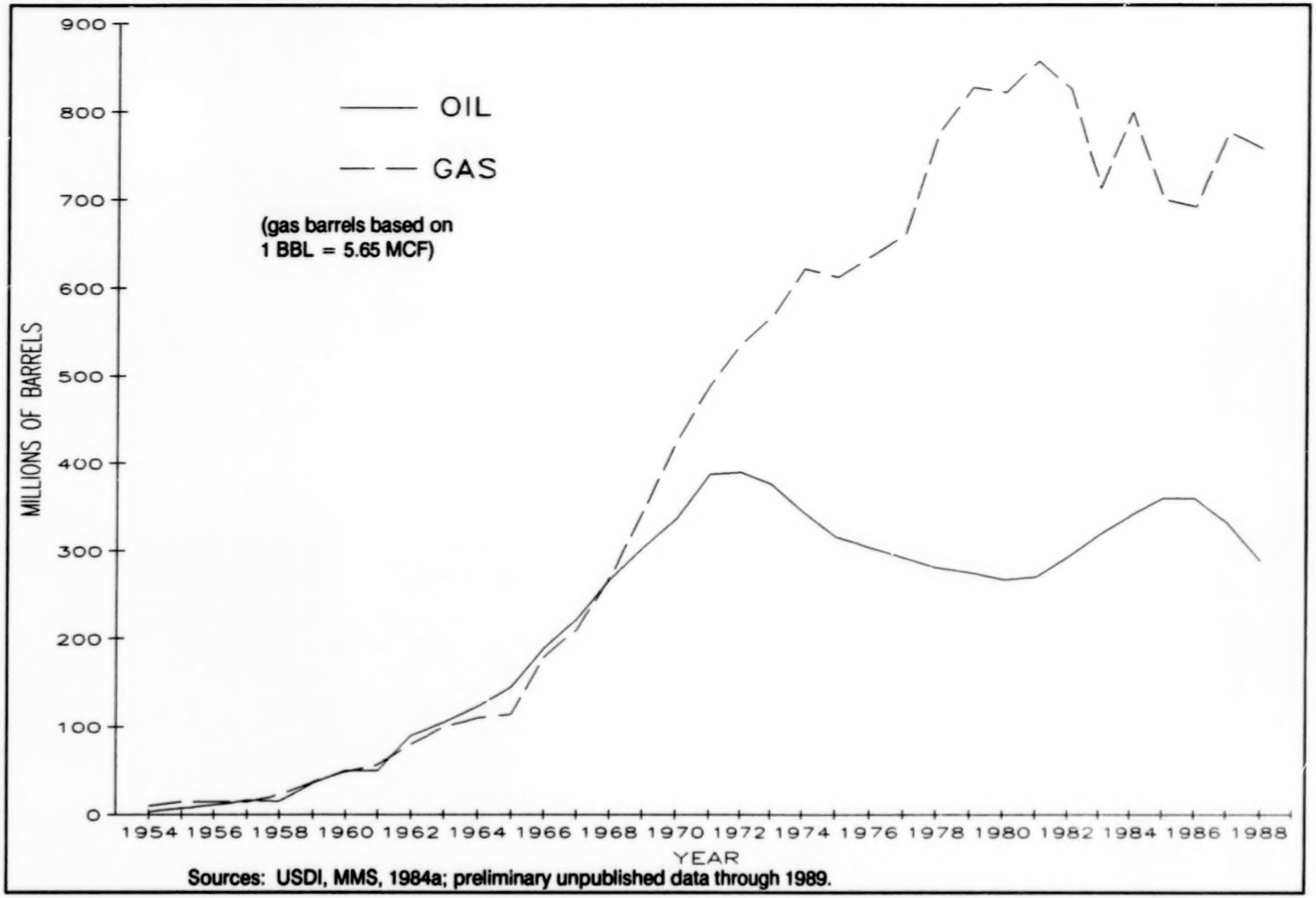
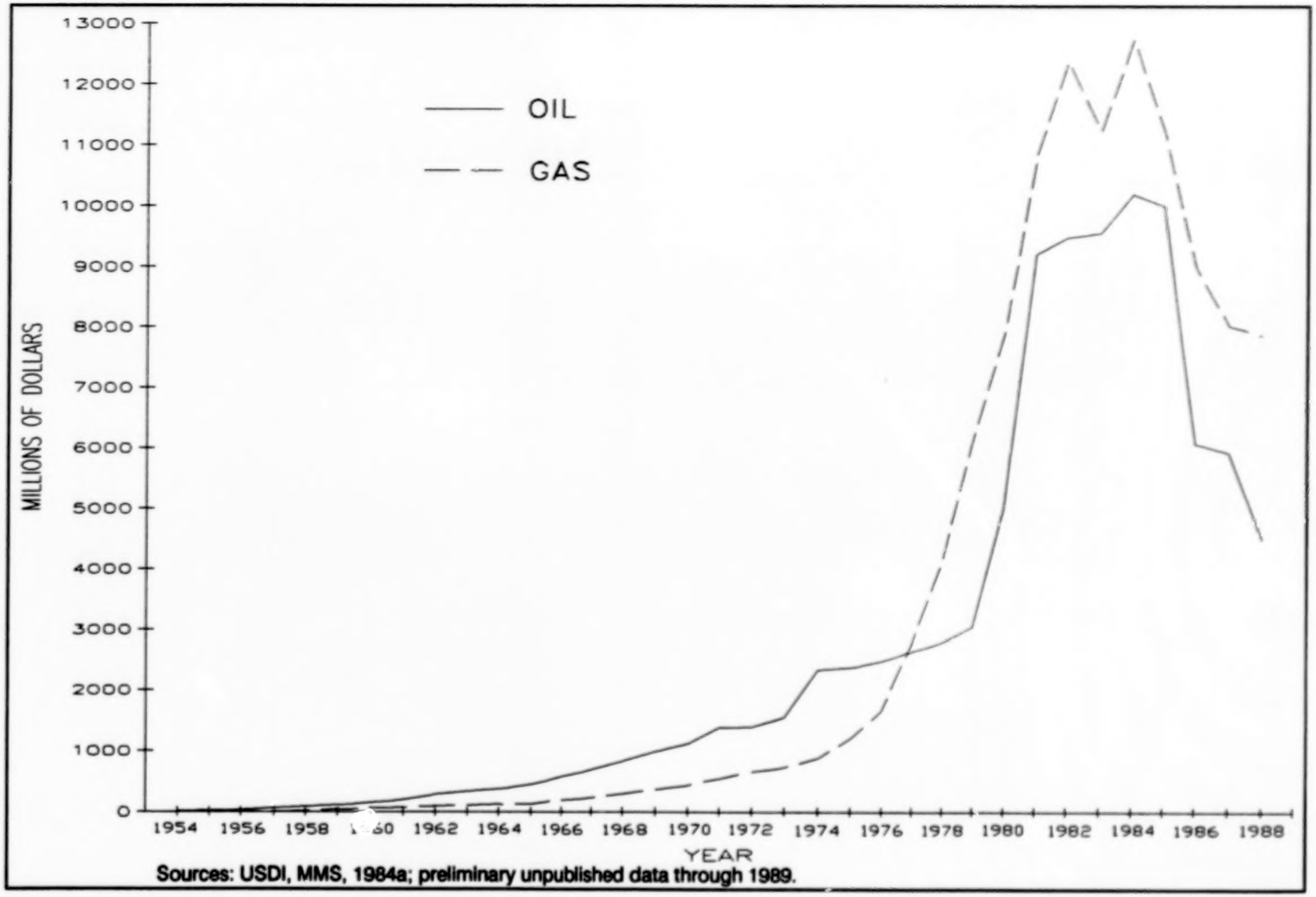


Sources: USDI, MMS, 1984a; preliminary unpublished data through 1989.

Figure III-12 . OCS Oil and Gas Production Off Louisiana and Texas from 1954 to 1989.



Sources: USDI, MMS, 1984a; preliminary unpublished data through 1989.

Figure III-13. Value of OCS Oil and Gas Produced Off Louisiana and Texas from 1954 to 1989.

Gulf, $0.5 billion for the Western Gulf, and less than $2 million for the Eastern Gulf). Average annual tax dollars generated per employee in the offshore oil and gas program are estimated at 8 percent of payroll revenues. Thus, the total amount of State and local taxes generated annually by the Federal offshore oil and gas program is estimated at $99.4 million from the Central Gulf, $38.5 million from the Western Gulf, and $0.1 million from the Eastern Gulf.

Job estimates as of June 1989 show that 72,000 jobs are directly or indirectly dependent on the offshore program. Approximately 70 percent of these jobs are associated with activity in the Central Gulf and 30 percent are related to the Western Gulf. A negligible portion of this total employment is related to OCS exploration in the Eastern Gulf. Nearly all offshore-related employment in the Central Gulf is due to activity offshore Louisiana. Estimates of direct employment offshore are as follows: 26,000 workers in the Central Gulf; 10,000 workers in the Western Gulf; and 100 workers in the Eastern Gulf.

Employment conditions as of June 1989 represent a 42 percent decline in the study area since the peak that occurred in December 1984. From an employment standpoint, the Gulf of Mexico coastal region has suffered considerable losses. This, in turn, has affected the amount of tax revenue generated in the study area. Currently, there is little information available that quantifies impacts related to the decline of the oil and gas industry on the economy as a whole. However, MMS is currently in the process of collecting information on depressed local economic conditions in the Gulf of Mexico OCS region. Contract studies are forthcoming.

2. Marine Transportation

The activity of waterborne commerce in the Gulf of Mexico predates the erection of the first oil and gas structure. Over the years, an extensive shipping pattern developed in relation to the locations of the major Gulf ports and the Straits of Florida. As oil and gas development began to move offshore, the potential for conflicts between marine transportation and oil and gas activities became a possibility. Since 1960, MMS has recorded vessel mishaps that sometimes involve collisions of varying severity. These mishaps commonly involve small service vessels and fixed structures on the OCS. An average of about one mishap involving a non-OCS vessel may occur in a 2-year period; OCS vessels (generally crewboats) contact platform structures about three times in a 2-year period. Many vessel mishaps result in minor property damage, and mishaps seldom cause loss of life.

The key mitigation factor for marine safety was the establishment of a series of shipping safety fairways, or traffic separation schemes (TSS's), and anchorages to provide unobstructed approach for vessels using U.S. ports (Visuals Nos. 3 and 3E). Shipping safety fairways are lanes or corridors in which no fixed structure, whether temporary or permanent, is permitted. The TSS's increase navigation safety by separating opposing lanes of vessel traffic. In fairway anchorages, which are areas contiguous to and associated with a fairway, fixed structures may be permitted within certain spacing limitations (33 CFR 166).

Fairways play an important role in the avoidance of collisions on the OCS, particularly in the case of the larger ocean-going vessels, but not all vessels stay within the fairways. Many, such as fishing boats and OCS support vessels, travel through areas that have high concentrations of fixed structures. In such cases, the most important mitigation factor is the requirement for adequate marking and lighting of structures. After a structure has been in place for a while, it often becomes a landmark and an aid to navigation for vessels that operate in the area on a regular basis. Most ocean-going vessels are equipped with radar capable of aiding navigation in all weather conditions. This has contributed to safe navigation on the OCS.

A substantial amount of domestic waterborne commerce along the Gulf Coast does not use open Gulf waters. Vessels engaged in this activity generally use the Gulf Intracoastal Waterway (GIWW), which follows the coastline inshore and through bays and estuaries from Fort Myers, Florida, to Brownsville, Texas (Visuals Nos. 1 and 1E).

3. Commercial Fishing Industry

The Gulf of Mexico provides 40 percent of the commercial fish landings and one-third of the recreational fishing activities in the continental U.S. (See Visuals Nos. 2 and 2E for major harvest areas.) Commercial landings of all fisheries in the Gulf during 1988 totaled nearly 1.9 billion pounds, valued at about $612 million

(USDC, NMFS, 1989a). This was an approximate 24 percent decrease in landings and a 15 percent decrease in value from 1987 (USDC, NMFS, 1988b). Most of this may be attributed to a 30 percent decrease in the landings of menhaden and a 13 percent decrease in the landings of shrimp. Cameron, Louisiana, was the second U.S. port in quantity of commercial fish landings in 1988, followed by Pascagoula-Moss Point, Mississippi; and Empire-Venice, Dulac-Chauvin, and Intercoastal City, Louisiana (USDC, NMFS, 1989a). Major Gulf-fisheries landing ports and statistics for 1986-1988 are listed in Table III-8.

Menhaden, with landings of 1.4 billion pounds, valued at $73 million, represented the most important Gulf species in quantity landed during 1988. Shrimp, with landings of 147 million pounds, valued at $416 million, represented the most important Gulf species in value landed during 1988 (USDC, NMFS, 1989a). Other significant Gulf commercial fisheries include oysters, blue crabs, and an assortment of finfish.

Commercial harvest of both oysters and crabs takes place in Gulf bays and estuaries. The Gulf oyster fishery accounted for 43 percent of the national total with landings of 17.2 million pounds of meats, valued at about $40 million. The Gulf blue crab fishery accounted for 40 percent of the national total with landings of 78 million pounds, valued at $31 million (USDC, NMFS, 1989a).

Excluding menhaden, at least 10 species of commercial finfish landed from the Gulf of Mexico during 1988 reached a minimum of $2 million each in value. In decreasing order of value, they are yellowfin tuna, grouper and scamp, black mullet, red snapper, swordfish, bluefin tuna, black drum, shark, spotted seatrout, and vermilion snapper.

Commercial fishing resources may generate at least three times the dockside value as the fisheries product moves through processing stages and wholesale and retail markets (Mager and Ruebsamen, 1989). In 1986, there were 1,012 processing and wholesale plants in the Gulf of Mexico that employed over 17,170 people (USDC, NMFS, 1988c). Processed fishery products are produced in every state of the Gulf of Mexico region. In 1986, the Gulf's processed fishery products amounted to about $1.3 million and represented about 25 percent of the comparable United States total. Of these processed products, shrimp ranked first in value--about 72 percent of the value of processed products for the Gulf region was related to shrimp production--and menhaden ranked second with about 8 percent. About 76 percent of all Gulf processing involved frozen packaged items followed by fresh products at 12 percent, industrial products at 8 percent, and canned items at 4 percent (USDC, NMFS, 1988c).

Central Gulf of Mexico

Alabama

Table III-9 contains 1988 commercial-landings data in order of decreasing value for Alabama. Alabama ranked last among the Gulf states in total commercial landings for 1988 with 15.7 million pounds landed, valued at $38.5 million. Shrimp was the most important fishery landed, with 8.9 million pounds valued at $34.9 million. In addition, the following four species each accounted for landings valued at over $200,000: blue crab, American oyster, red snapper, and black mullet (USDC, NMFS, 1989a). Table III-10 contains the commercial catch for Mobile Bay.

In 1986, there were approximately 2,233 commercial-fish landings on the Alabama coast, where processed fishery products amounted to $175 million. The main processed fishery products were shrimps, crabs, and oysters (USDC, NMFS, 1988c).

Mississippi

Table III-9 contains 1988 commercial-landings data in order of decreasing value for Mississippi. Mississippi ranked second among Gulf states in total commercial-fishery landings for 1988 with 290 million pounds landed, valued at $43.7 million. Shrimp was the most important fishery with 7.8 million pounds landed, valued at about $25.5 million. Menhaden landings were significant during 1988 with 277 million pounds landed, valued at $15 million. In addition, the following five species each accounted for landings valued at over $250,000: red snapper, blue crab, American oyster, black mullet, and yellowfin tuna (USDC, NMFS, 1989a). Table III-10 contains the commercial catch for Mississippi Sound.

Table III-8

Major Gulf of Mexico Fisheries Landings, Ports, and Statistics

	1985		1986		1987		1988	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Texas								
Brownsville-Port Isabel	22.9	49.6	25.5	69.3	13.4	54.2	13.8	39.7
Aransas Pass-Rockport	24.2	43.0	27.1	60.3	10.2	36.4	15.6	45.6
Freeport	8.8	17.2	**	26.7	**	23.6	**	22.6
Galveston	12.8	13.4	**	20.9	**	11.4	**	21.4
Port Arthur	11.6	22.6	**	29.9	**	22.9	**	17.4
Louisiana								
Cameron	673.6	29.9	616.8	34.8	672.4	31.9	438.9	33.2
Dulac-Chauvin	398.6	59.9	294.6	71.0	331.7	65.6	244.1	56.5
Delcambre	**	12.7	18.7	28.4	13.9	22.1	10.8	12.7
Lafitte-Barataria	20.6	29.0	16.8	24.1	12.7	19.2	11.9	16.0
Empire-Venice	224.5	34.3	317.6	47.1	357.4	60.1	297.2	67.7
Golden Meadow-Leeville	18.2	23.5	40.0	25.1	36.6	27.4	37.4	30.1
Grand Isle	11.1	12.4	14.0	11.9	12.3	12.6	10.8	12.0
Delacroix-Yscloskey	11.0	10.6	16.3	12.5	12.5	13.1	11.1	11.0
Mississippi								
Pascagoula-Moss Point	423.2	18.4	365.5	20.4	391.6	20.3	292.0	28.2
Biloxi	41.1	13.4	46.7	15.2	38.2	14.2	42.3	29.5
Alabama								
Bayou La Batre	21.0	30.4	25.6	43.3	15.1	29.8	12.4	23.8
Bon Secour-Gulf Shores	--	10.2	--	13.5	--	13.0	--	12.5
Florida								
Apalachicola	10.0	12.4	**	11.5	**	10.4	10.0	12.0
Key West	15.3	23.3	**	27.4	**	22.4	15.3	16.8

(1) quantity (million pounds)
(2) value (million dollars)

Note: ** Landings less than six million pounds.
-- To avoid disclosure of private enterprise, information from certain leading ports have not been included.

Source: USDC, NMFS, 1989a.

Table III-9

Commercial Landings (1988)

Species	Pounds	Dollars
Florida, West Coast		
Shrimp	15,708,017	40,055,443
Stone Crab	4,928,072	27,892,888
Spiny Lobster	5,794,267	15,992,177
Grouper and Scamp	8,439,532	12,828,089
Black Mullet	20,356,650	8,956,926
Oyster	2,065,771	4,090,227
Yellowtail Snapper	1,299,138	2,351,440
Red Snapper	886,961	2,048,880
Yellowfin Tuna	1,116,115	1,450,950
Alabama		
Shrimp	8,991,788	34,971,912
Blue Crab	3,869,458	1,551,395
Black Mullet	1,282,634	820,315
Oyster	103,241	276,092
Red Snapper	92,581	205,842
Flounder	154,423	137,912
Mississippi		
Shrimp	7,814,264	25,542,670
Menhaden	277,102,620	14,990,154
Red Snapper	397,897	621,599
Yellowfin Tuna	302,129	519,293
Oyster	146,602	464,060
Blue Crab	862,872	327,109
Louisiana		
Shrimp	65,166,144	149,607,379
Menhaden	1,116,647,885	57,098,934
Oyster	13,253,772	31,208,400
Blue Crab	53,554,485	21,447,335
Yellowfin Tuna	12,391,978	18,830,590
Red Snapper	1,820,071	4,214,381
Swordfish	1,320,647	4,098,235
Bluefin Tuna	254,545	3,474,235
Black Drum	8,756,913	2,347,837
Shark	4,028,105	1,791,122
Black Mullet	2,367,106	1,515,118
Spotted Seatrout	1,433,408	1,498,464
Texas		
Shrimp	49,833,613	165,802,024
Yellowfin Tuna	2,688,835	5,327,566
Oyster	1,671,294	4,242,115
Blue Crab	9,889,320	4,032,843
Red Snapper	757,378	1,589,225
Black Drum	698,125	509,010

Source: USDC, NMFS, 1989a.

Table III-10

Catch by Bay System

Species	Value ($)	Pounds
Charlotte Harbor, 1988*		
Black Mullet	5,335,776	5,365,993
Blue Crab	2,376,715	2,412,324
Menhaden	904,132	910,596
Spotted Sea Trout	315,539	316,296
Crevalle	202,972	202,979
Unclassified Finfish, Bait	173,339	173,340
Unclassified Finfish	137,813	139,323
Atlantic Sheepshead	119,813	120,989
Tenpounder or Ladyfish	82,370	83,186
Sand Perch	55,832	64,715
Totals	9,704,301	9,616,914
Sarasota and Tampa Bays, 1988*		
Black Mullet	3,724,643	3,808,271
Shrimp	378,834	182,438
Shark	372,322	383,980
Blue Crab	312,903	317,250
Spanish Sardine	284,526	303,786
Crevalle	190,477	192,341
Spotted Sea Trout	127,206	127,548
Spanish Mackerel	104,723	106,967
Unclassified Finfish, Bait	96,162	96,260
Tilapia (Nile Perch)	85,372	86,707
Totals	5,677,168	5,605,548
Apalachicola Bay, 1988*		
Shrimp	1,267,734	946,909
Oyster	1,192,516	1,194,750
Blue Crab	546,921	543,921
Black Mullet	146,248	152,595
Bay Scallop	29,143	30,137
Flounders	17,647	18,169
Spotted Sea Trout	4,383	4,537
King Whiting (King Fish)	1,287	1,373
Silver Mullet	559	559
White Sea Trout	552	557
Totals	3,206,990	2,893,507
Mobile Bay, 1988*		
Shrimp	5,784,022	1,849,484
Blue Crab	1,266,415	3,150,376
Black Mullet	619,942	1,087,607
Flounders	72,230	65,670
Atlantic Sheepshead	40,908	170,292
Oyster	40,522	13,418
Black Drum	24,206	116,573
King Whiting (King Fish)	24,202	64,162
Pompano	6,263	2,130
Spot	5,384	24,338
Totals	7,884,094	6,544,050

Table III-10. Catch by Bay System (continued)

Mississippi Sound, 1988*		
Shrimp	8,967,580	2,848,494
Blue Crab	571,082	1,491,094
Oyster	552,442	189,135
Black Mullet	442,970	777,794
Spotted Sea Trout	73,275	63,248
Red Drum	38,723	38,230
Flounders	18,509	23,071
King Whiting (King Fish)	18,210	44,728
Atlantic Sheepshead	12,340	71,488
Unclassified Finfish, Bait	8,892	24,649
Totals	10,704,023	5,571,931
Breton and Chandeleur Sounds, 1988*		
Shrimp	22,184,878	8,939,083
Menhaden	9,106,432	167,535,565
Oyster	6,320,529	2,462,378
Blue Crab	3,818,367	7,976,425
Black Mullet	1,252,263	1,620,615
Black Drum	749,164	2,284,668
Spotted Sea Trout	250,530	221,396
Atlantic Sheepshead	206,748	1,050,911
Red Drum	47,883	29,701
Flounders	34,673	35,872
Totals	43,971,467	192,156,614
Barataria Bay, 1988*		
Shrimp	19,453,495	10,765,456
Oyster	15,0133,603	5,826,825
Blue Crab	4,553,943	11,877,693
Spotted Sea Trout	709,120	674,842
Black Drum	662,543	2,284,113
Soft-shell Blue Crab	146,004	50,023
Red Drum	211,192	134,588
Atlantic Sheepshead	62,592	402,079
White Sea Trout	61,723	63,918
Flounders	44,411	48,762
Totals	176,038,626	32,128,299
Terrebonne and Timbalier Bays, 1988*		
Shrimp	17,022,119	10,043,149
Blue Crab	6,442,206	16,395,654
Oyster	5,672,141	2,946,411
Black Drum	439,377	2,371,781
Spotted Sea Trout	157,598	148,949
Red Drum	38,477	42,665
Flounders	24,665	30,706
Atlantic Sheepshead	17,036	99,827
Soft-shell Blue Crab	14,195	5,073
Black Mullet	4,703	10,195
Totals	29,832,517	32,094,410

Table III-10. Catch by Bay System (continued)

Atchafalaya Bay and Surrounding Estuaries, 1988*		
Blue Crab	5,201,710	13,784,155
Shrimp	1,446,281	883,325
Oyster	1,316,684	584,106
Black Drum	238,016	454,250
Black Mullet	215,174	271,281
Spotted Sea Trout	144,687	157,479
Flounders	73,737	77,052
Red Drum	41,792	32,306
Atlantic Sheepshead	2,701	16,446
Shark	828	3,197
Totals	8,681,610	16,263,597
Vermilion Bay and Surrounding Estuaries, 1988*		
Shrimp	4,518,940	2,648,771
Blue Crab	1,042,153	2,617,561
Oyster	672,420	264,538
Spotted Sea Trout	127,040	133,672
Black Drum	46,778	77,093
Flounders	33,768	36,812
Atlantic Sheepshead	3,967	18,866
White Sea Trout	1,753	5,457
Totals	6,446,819	5,802,770
Galveston Bay, 1988*		
Shrimp	8,023,248	6,539,452
Oysters	3,921,794	1,452,365
Blue Crab	1,517,520	3,118,874
Unclassified Finfish, Scrap	73,894	206,282
Black Drum	55,643	61,297
Flounders	55,457	47,299
Atlantic Sheepshead	17,798	73,893
Black Mullet	10,690	64,553
Squid	10,253	23,800
Red Snapper	6,990	2,764
Totals	13,693,287	11,590,579

*Not all species are listed.

Sources: Davenport, written comm., 1989; Hightower, written comm., 1989; Usie, written comm., 1989.

In 1986, there were approximately 2,372 commercial-fish landings on the Mississippi coast where processed fishery products amounted to $188 million. The main processed fishery products were shrimps, menhaden, oysters, and crabs (USDC, NMFS, 1988c).

Louisiana

Table III-9 contains 1988 commercial-landings data in order of decreasing value for Louisiana. Louisiana ranked first among Gulf states in total commercial-fishery landings for 1988 with nearly 1.4 billion pounds landed, valued at $316.5 million. Nationally, the Louisiana catch ranked second in volume and third in value. Louisiana landed 44 percent of the shrimp, 75 percent of the oysters, 80 percent of the menhaden, and 68 percent of the blue crabs harvested from the Gulf in 1988. Menhaden represents the highest quantity with 1.1 billion pounds landed, valued at $57 million. Shrimp represents the highest value with 65 million pounds landed, valued at $150 million. In addition, the following 11 species each accounted for landings valued at over $1 million: spotted seatrout, red snapper, vermilion snapper, bluefin tuna, yellowfin tuna, black drum, blue crab, American oyster, shark, black mullet, and swordfish (USDC, NMFS, 1989a). Table III-10 contains the commercial catch for bays and sounds along the Louisiana coast.

In 1986, there were approximately 5,610 commercial-fish landings on the Louisiana coast, where processed fishery products amounted to about $444 million. The main processed fishery products were shrimps, menhaden, oysters, and crabs (USDC, NMFS, 1988c).

Western Gulf of Mexico

Texas

Table III-9 contains 1988 commercial-landings data in order of decreasing value for Texas. Texas ranked third among Gulf states in total commercial-fishery landings for 1988 with nearly 67.8 million pounds landed, valued at $182 million. Shrimp represents both the highest quantity and value at about 49.8 million pounds, valued at $165.8 million. In addition, the following four species each accounted for landings valued at over $1 million: red snapper, yellowfin tuna, blue crab, and American oyster (USDC, NMFS, 1989a). Table III-10 contains the commercial catch for Galveston Bay.

In 1986, there were approximately 2,275 commercial-fish landings on the Texas coast where processed fisheries products amounted to about $175 million. The main processed fishery products were shrimps, oysters, and crabs (USDC, NMFS, 1988c).

Eastern Gulf of Mexico

Florida

Table III-9 contains 1988 commercial-landings data in order of decreasing value for the west coast of Florida. Florida's west coast ranked fourth among Gulf States in total commercial landings for 1988 with 143 million pounds landed, valued at $131.4 million. Shrimp was the most important fishery landed, with 15.7 million pounds valued at $40 million. In addition, the following eight species each accounted for landings valued at over $1 million: stone crab, spiny lobster, grouper and scamp, black mullet, American oyster, yellowtail snapper, red snapper, and yellowfin tuna (USDC, NMFS, 1989a; Muller, written comm., 1989). Table III-10 contains the commercial catch for bays along the west coast of Florida.

In 1986, there were approximately 4,680 commercial-fish landings on the Florida west coast, where processed fishery products amounted to $363 million. The main processed fishery products were shrimps, spiny lobsters, crabs, and oysters (USDC, NMFS, 1988c).

4. Recreational Resources and Activities and Associated Tourism

The northern Gulf of Mexico coastal zone is one of the major recreational regions of the United States, particularly in connection with marine fishing and beach-related activities. The shorefronts along the Gulf coasts of Florida, Alabama, Mississippi, Louisiana, and Texas offer a diversity of natural and developed landscapes and seascapes. The coastal beaches, barrier islands, estuarine bays and sounds, river deltas, and tidal marshes are extensively and intensively used for recreational activity by residents of the Gulf Coast States and tourists from throughout the nation, as well as from foreign countries. Publicly-owned and administered areas, such as national seashores, parks, beaches, and wildlife lands, as well as specially designated preservation areas, such as historic and natural sites and landmarks, wilderness areas, wildlife sanctuaries, and scenic rivers, attract residents and visitors throughout the year. Commercial and private recreational facilities and establishments, such as resorts, marinas, amusement parks, and ornamental gardens, also serve as primary-interest areas and support services for people who seek enjoyment from the recreational resources associated with the Gulf of Mexico.

Table III-11 presents a classification system for the major established Gulf of Mexico shorefront and offshore public and private recreational resources. Visuals Nos. 3 and 3E provide a synoptic view of the location, extent, and components of the specific recreational areas within these systems onshore and offshore. Table III-12 provides selected statistics collected on a statewide/regionwide basis; these statistics will provide a general feeling for the relative distribution of people, resources, and activities associated with the Gulf of Mexico. Although most of the statistics presented in Table III-12 are quite broad, it can generally be deduced that almost 40 million residents of the Gulf Coast States have a major interest in water-related and water-enhanced recreational activity, with approximately two-thirds of the Gulf shorefront composed of beach; also, there is one motorboat for about every 20 people living in the Gulf region. In an attempt to narrow the scope of this information to the coastal zone, approximately 14 million people, or 35 percent of the Gulf States' population, live in coastal counties/parishes or the area most directly affected by Gulf activity; and about one-third of the 2 million registered motorboats (16 ft or greater) are likely candidates for use in association with marine recreational activity.

Between 1984 and 1987 NOAA's Office of Strategic Assessment inventoried public recreation areas in coastal areas throughout the U.S. Their final report and data atlas (USDC, NOAA, 1988c) indicates 308 public agencies (289 local, 14 State, and 5 Federal) owned and/or managed outdoor recreation areas and facilities in coastal areas of the Gulf of Mexico region. Public agencies managed 4,137 recreation sites greater than one acre in size in the Gulf's coastal zone. According to NOAA's report, 601 of these public recreation sites provide access to tidally influenced water and 215 provide access to the open waters of the Gulf of Mexico. The atlas provides extensive data on public recreation lands and waters, as well as the number of boat ramps, boating slips, docks, fishing piers, campsites, artificial reefs, and beach miles of every coastal county/parish associated with the Gulf of Mexico region.

The two major recreational areas most directly associated with and potentially affected by offshore leasing are the offshore marine environment and the coastal shorefront of the adjoining states. The major recreational activity occurring on the OCS is offshore marine recreational fishing and diving. Studies, reports, and conference proceedings published by MMS and others have documented a substantial recreational fishery, including scuba diving, directly associated with oil and gas production platforms. The recreational fishing associated with oil and gas structures stems from their function as high-profile, artificial fishing reefs. A report on the 1984 Marine Recreational Fishery Statistics Surveys presented by NMFS at the Sixth Annual Gulf of Mexico Information Transfer Meeting (Witzig, 1986) indicates a majority of the offshore recreational fishing in the CPA is directly associated with oil and gas structures. There are currently about 4,500 offshore oil and gas structures in the CPA and WPA. Many other studies (Ditton and Auyong, 1984; Roberts and Thompson, 1983; Ditton and Graefe, 1978; Dugas et al., 1979) have demonstrated that when oil and gas structures are accessible to marine recreational fishermen and scuba divers they are a major attraction for marine recreational activities and are a positive influence on tourism and coastal economics. Throughout the Gulf of Mexico region, there is high interest in acquiring, relocating, and retaining selected oil and gas structures in the marine environment as dedicated artificial reefs to enhance marine fisheries when the structures are no longer useful for oil and gas production (Reggio, 1989a). There have been a few Gulf

Table III-11

Gulf of Mexico Shorefront and Marine Recreational Classification Systems

Recreational Resources	Texas	Louisiana	Mississippi	Alabama	Florida	OCS
National Systems						
National Park System Areas						
National Seashores	x		x		x	
National Parks					x	
National Preserves					x	
National Monuments					x	
National Memorials					x	
National Historic Parks		x				
National Wildlife Refuges	x	x		x	x	
National Wilderness Areas		x			x	
National Register Sites	x	x	x	x	x	x
National Natural Landmarks				x	x	
National Marine Sanctuaries					x	x
National Estuarine Sanctuaries				x	x	
National Fishing Areas (Economic Exclusion Zone)						x
State Systems						
State Park System Areas						
State Parks	x	x	x	x	x	
State Recreation Areas	x				x	
State Historical or Commemorative Areas	x	x			x	
State Historic Sites or Structures	x	x	x	x	x	
State Fishing Piers	x	x		x	x	
State Wildlife Management and Conservation Areas	x	x			x	
State Wildlife Refuges and Preserves		x			x	
State Wilderness Areas					x	
State Preserves					x	

Table III-11. Gulf of Mexico Shorefront and Marine Recreational Classification Systems (continued)

Recreational Resources	Texas	Louisiana	Mississippi	Alabama	Florida	OCS
State Systems (continued)						
State Aquatic Preserves					x	
Environmentally Endangered Lands					x	
Natural Scenic, Wild, or Recreational Rivers	x	x	x		x	
State Sponsored Artificial Fishing Reefs	x	x	x	x	x	x
State Recreation or Conservation Lands					x	
State Areas of Critical Concern					x	
State Fishing Areas	x	x	x	x	x	
Local Systems (county/parish/municipal)						
Parks and Beaches	x	x	x	x	x	
Artificial Reefs					x	x
Fishing Piers	x		x	x	x	
Marinas and Access Sites	x	x	x	x	x	
Private Systems						
Audubon Society Sanctuaries	x	x		x	x	
Artificial Reefs	x		x		x	x
Fishing Piers	x	x	x	x	x	
Shorefront Resort Developments	x	x	x	x	x	
Marinas and Access Sites	x	x	x	x	x	

Table III-12

Selected Gulf of Mexico Statistics

State/Planning Area	Population (1986)[1] (thousands)	OCS Acres (thousands)	Motor Boat Registrations (1988)[2] (thousands)	Paid Fishing License Holders (1986[3]) (thousands)	Participation in Marine Rec. Fishing (1985)[4] (thousands)	General Coastline[5] (miles)	Beach Length[6] (miles)
Central Gulf							
Louisiana	4,501.0		293.4	578.2	759	397	365
Mississippi	2,625.0		159.4	473.9	263	44	27
Alabama	4,053.0		212.4	612.1	226	53	45
Total	11,179.0	45,000	665.2	1,664.2	1,248	494	437
Western Gulf							
Texas	16,682.0		607.1	1,934.8	NA	370	361
Total	16,682.0	35,000	607.1	1,934.8		370	361
Eastern Gulf							
Florida	11,675.0		675.5	844.2	3,151	943	403
Total	11,675.0	71,000	675.5	844.2	3,151	943	403
Gulfwide	39,536.0	152,500	1,947.8	4,443.2	NA	1,807	1,199

Sources:
[1] U.S. Dept. of Commerce, Bureau of Economic Analysis, 1988.
[2] U.S. Dept. of Transportation, Coast Guard, 1989a.
[3] Sports Fishing Institute, 1987.
[4] U.S. Dept. of Commerce, NMFS, 1987.
[5] U.S. Dept. of Commerce, NOS, 1975.
[6] U.S. Dept. of the Army, Corps of Engineers, 1971.

Note: The figures listed under "OCS Acres" include both leased and unleased blocks.

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regionwide investigations producing annual use data focusing specifically on marine-related recreational activity; one example is the Marine Recreational Fisheries Statistics Survey for the Gulf and Atlantic Coasts published by NMFS. Unfortunately, data from Texas was excluded from the latest survey report (USDC, NMFS, 1987). A special report by Schmied and Burgess (1987) indicates there were about four million resident participants in marine recreational fishing and over two million tourists who angle for marine species associated with the Gulf of Mexico. Marine anglers in the Gulf of Mexico made almost 25 million fishing trips in 1985.

The Sports Fishing Institute (1988) estimated resident and tourist sport fishermen in the five Gulf States spent an estimated $6.5 billion, generating a total economic output exceeding $10 billion and accounting for 188,000 person years of employment in 1985 (Table III-13). Schmied and Burgess (1987) estimated the sales generated from saltwater fishing alone in 1985 in the five Gulf States at $1.4 billion, accounting for 17,120 person years of employment. Conclusively, sports fishing in the marine environment of the Gulf region is a major industry that is important to the economic viability of each Gulf State. Furthermore, the U.S. Fish and Wildlife Service (USDI, FWS, 1988b) estimated that 31 percent of American saltwater fishermen did some deep-sea fishing (more than 3 mi offshore).

Table III-13

Economic Impact of Sport Fishing in the Gulf States

	Expenditures (dollars in millions)	Output (dollars in millions)	Person Years of Employment
Texas	1,900.0	3,300.0	53,089
Louisiana	538.5	893.4	15,104
Mississippi	428.0	806.7	16,160
Alabama	519.1	804.4	16,754
Florida	3,100.0	4,200.0	85,584
Total	6,485.6	10,004.5	187,691

Source: Sports Fishing Institute. 1988.

As noted on Visuals Nos. 3 and 3E, the coastal shorefronts of the CPA, WPA, and EPA contain extensive public and private park and recreational areas. Most of the outdoor recreational activity focused on the Gulf of Mexico shorefront is associated with accessible beach areas. Major recreational beaches are delineated on the front of Visuals Nos. 3 and 3E and are individually listed and further described on the backs of these visuals. According to NOAA (USDC, NOAA, 1988c), there are 670 mi of public recreational beaches along the Gulf Coast. These beaches are a major inducement for coastal tourism, as well as being a primary resource for resident recreational activity.

According to NOAA (Meade and Leeworthy, 1986), $525 million in public funds were spent in FY 1982 for outdoor recreation in coastal counties of the Gulf of Mexico region, an average of $44 per resident. Total public recreation expenditures and expenditures per capita are less in the Gulf Coast region than in any other coastal region of the United States (Pacific, South Atlantic, and North Atlantic). Notwithstanding the Gulf's low ranking, three South Florida coastal counties (Dade, Palm Beach, and Broward) and one Texas coastal county (Harris) ranked among the top 20 coastal counties in the nation (1,339 counties) for public recreation expenditures in FY 1982. This is not surprising considering tourism is Florida's number-one industry and that local governments spend considerable sums maintaining beaches. This study, along with Visuals Nos. 3 and 3E and the previous discussion, points out that recreational resources, activities, participation, and expenditures are not constant along the Gulf of Mexico shorefront but are focused in major areas primarily where public beaches and major urban centers are closely related.

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Travel Industry

Central Gulf of Mexico

According to data from a study prepared for the Alabama Bureau of Tourism and Travel by the Department of Marketing and Transportation at Auburn University (1987), tourist-related travel expenditures in Alabama amounted to about $4.3 billion in 1987, up 8 percent from 1986. Approximately 25 percent of this ($1.1 billion) can be directly attributed to the seven-county Gulf region, which includes Washington, Clarke, Monroe, Conecum, Escambia, Baldwin, and Mobile Counties. Such travel expenditures generated more than 78,000 jobs, as well as $160 million in State retail sales tax collections, excluding gasoline tax receipts. About 12 percent of the travelers (21% of Alabama residents and 11% of nonresidents) cited Alabama Gulf Coast beaches as their destination. The highest percentage use of the Alabama Gulf Coast beaches was in the summer (18%) and spring (12%) months, with the lowest use occurring in fall (7%) and winter (6.3%). Lower expenditures per party in winter than in other seasons were also noted. According to the Alabama report, going to the beach was one of the three activities that generated the largest expenditures per party. The average expenditure per travel party visiting beaches was $482, up 32 percent from 1986. Of each spent, 29 cents went for food/beverage, 29 cents for lodging, 16 cents for automobile expense, 10 cents for entertainment, 4 cents for recreation, and 12 cents for incidentals. Tourists visiting beaches in Alabama spent an average number of 4.9 days and 4.2 nights. The average party size was 3.4. All five of the Gulf Coast States were ranked (in percent) among the top 10 states from where party trips to Alabama originated. Gulf States were ranked as follows: Alabama, 55.3 percent; Louisiana, 6.2 percent; Florida, 5.2 percent; Texas, 4.8 percent; and Mississippi, 2.5 percent.

Data prepared for the Mississippi Department of Economic Development (U.S. Travel Data Center, 1987) indicate that in the Mississippi Gulf region, travel expenditures amounted to over $300 million, representing about 22 percent of comparable statewide expenditures. The highest expenditure categories were food services and auto transportation, with the lowest expenditures occurring in the categories of entertainment/recreation and public transportation. Almost $58 million, or 21 percent of the State's total payrolls, served as payrolls to the Gulf Coast region's 7,800 employees. On the average, every $41,000 spent by travelers in Mississippi directly supported one job during 1986. Food services accounted for 40 percent of the State's total payroll and 52 percent of the State's total employment generated by travel, while lodging accounted for 18 percent of payroll and 19 percent of employment. State and local tax receipts from the coast's travel expenditures equaled almost $19 and $6 million, respectively. On the average, each travel dollar produced 11.4 cents in Federal tax receipts, 5.7 cents in State tax receipts, and 1.4 cents in local tax receipts.

Data prepared for the Louisiana Office of Tourism (1989) indicate that in the Louisiana Gulf region, travel expenditures amounted to over $3.2 billion in 1988, representing about 85 percent of comparable statewide expenditures. The highest expenditure categories were auto transportation, food service, and public transportation, with the lowest expenditures occurring in the categories of lodging, entertainment/recreation, and incidentals. On the average, every $54,000 spent by travelers in Louisiana directly supported one job during 1988. State and local tax receipts from these travel expenditures equalled $208 and $90 million, respectively. On the average, each travel dollar produced 5.1 cents in State tax receipts. Each travel dollar produced about 2.2 cents for local tax receipts. Over 80 percent of the study region's travel expenditures occur in Orleans Parish. Unlike tourism in other parts of the Gulf region, very little activity is associated with Louisiana Gulf beaches; instead, major attractions include a variety of sports events, festivals, conventions, and sightseeing activities occurring in or near major urban centers such as New Orleans, Baton Rouge, Lafayette, and Lake Charles.

Western Gulf of Mexico

According to data from the University of Texas at Austin (1987), total travel expenditures in the Texas Gulf region were about $5.3 billion in 1986, or 31 percent of the comparable State total. These expenditures provided almost 90,000 jobs to Texas residents in the coastal region with payrolls of about $1.2 billion. These figures represent a 5 percent decrease in travel-related jobs since 1984. Related State and local tax receipts for the Gulf region in 1986 were approximately $185 and $119 million, respectively. About 92 percent of the Texas Gulf region's travel expenditures occurred in major metropolitan areas that are in close proximity to popular Texas Gulf beaches, specifically in Cameron, Galveston, Harris, Jefferson, and Nueces Counties.

Eastern Gulf of Mexico

Tourism has long been recognized as an important element in the Florida economy. According to the Florida Visitor Study for 1987, over 34 million visitors traveled to the State in that year, spending more than $21.7 billion on tourism/recreation-related activities (Florida Dept. of Commerce, Division of Tourism, 1987). Approximately 46 percent of these total State visitors (15 million) and 48 percent of these expenditures ($10.4 billion) were directly related to the Gulf Coast counties in the EPA. Popular attractions in the region include the Everglades, several State parks, beaches and associated swimming sites, sport fishing, and numerous activities in the larger metropolitan areas such as Miami, Tallahassee, and Tampa.

Of the total State visitors traveling by auto, 38 percent reported destinations within the area of concern for this analysis, which includes the entire Gulf Coast of Florida and Dade County on the Atlantic Coast. The major counties visited in the study area for auto travelers were along the Emerald Coast and in Central Florida: Bay, Pinellas, Hillsborough, Okaloosa, and Escambia. Auto visitors surveyed cited rest/relaxation, recreating on beaches, and visiting friends/relatives as their most likely activities while vacationing in Florida.

Of the total State visitors traveling by air, 54 percent reported traveling to counties within the study area. The major Gulf Coast counties of destination for these air visitors were in Central and South Florida: Dade, Pinellas, Hillborough, Monroe, Lee, and Sarasota. The air visitors to Florida cited rest/relaxation, enjoying the climate, and recreating on beaches as their most likely activities.

In 1987, visitors to Florida generated 280,200 jobs, an increase of 8.0 percent from the 1986 level of travel-related employment. These visitors contributed over $557 million in tourism/recreation sales tax and local-option tax collections in Florida for 1987. These tax collections were 9.2 percent of that year's total tax collections for the State.

5. Archaeological Resources

Archaeological resources are any objects or features that are manmade or modified by human activity. Significant archaeological resources are either historic or prehistoric and, as defined by 36 CFR 60.6, generally include properties that are greater than 50 years old and are associated with events that have made a significant contribution to the broad patterns of our history; are associated with the lives of persons significant in the past; embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; possess high artistic values; represent a significant and distinguishable entity whose components may lack individual distinction; or have yielded, or may be likely to yield, information important in prehistory or history.

The State Historic Preservation Officers for all Gulf Coast States were contacted and requested to indicate which sites on the National Register of Historic Places within their coastal zones could potentially be affected by OCS leasing activities. These sites, which include historic buildings, forts, lighthouses, and shipwrecks, are depicted on Visuals Nos. 3 and 3E. Because most historic archaeological resources on the OCS are shipwrecks, they are the focus of the discussion in Section III.C.5.a. below. Section III.C.5.b. discusses possible prehistoric-resource sites. As explained in more detail below, these discussions include references to Zones 1 (a high-probability zone for the occurrence of shipwrecks) and 2 (a zone of high probability for the occurrence of landforms potentially associated with prehistoric settlement sites).

a. Historic

Although most historic archaeological resources on the OCS are shipwrecks, other types of historic sites, such as the Ship Shoal Lighthouse, may occur in Federal waters.

A literature search for reported ship losses and known shipwrecks was conducted as part of the archaeological resources baseline study for the northern Gulf of Mexico (CEI, 1977). This study indicated that less than 2 percent of pre-20th century ships reported lost in the Gulf and less than 10 percent of all ships reported lost between 1500 and 1945 have known locations (110 out of 1,589). Considering the problems with inaccurate wreck reporting, drift and breakup of wrecks, and ships that have been lost but never reported, it becomes apparent that very little is really known about the locations of historic shipwrecks in the Gulf of Mexico.

In order to deal with the management problems of this largely unlocated resource base, a high-probability zone for the occurrence of shipwrecks (Archaeological Resource Zone 1) was proposed by the baseline study (CEI, 1977). This zone was delineated by using geographic factors, such as approaches to seaports, straits, shoals, reefs, and historic shipping routes, as indicators of high shipwreck potential.

Texas A&M University has recently completed a study for MMS that updated and expanded the list of historic shipwrecks developed by CEI (Garrison et al., 1989). This recent investigation identified over 5,000 potential shipwreck locations in the Gulf, nearly 1,500 of which occur on the OCS. The study also investigated the relationship between factors such as ocean currents, storm tracks, natural navigational hazards, the economic history of port development and usage, and the distribution of shipwreck patterns. The results of these analyses indicate that many of the shipwrecks on the OCS occur in clustered patterns related mainly to navigation hazards and port entrances.

Once a ship goes down, the spatial distribution of site materials (integrity/preservation of the site) is governed by sea state, water depth, type of bottom, nature of the adjacent coast, strength and direction of storm currents and waves, and the size and type of construction of the vessel. The recent MMS-funded study investigated how these variables affect shipwreck-preservation potential.

The major factor that would affect the integrity of shipwreck sites in the Central Gulf are the Holocene deltaic sediments that comprise the bottom sediments in the eastern part of the planning area. These sediments would protect site components as they settled. An excellent example is provided by the excavation of the eighteenth century Spanish galleon, the *El Nuevo Constante*, off Cameron Parish, Louisiana (Pearson, 1981). This wreck displayed excellent preservation of organic materials (e.g., leather, bone, and wood) because of the unconsolidated clays that encapsulated the wreck, creating an anaerobic environment. This high degree of wreck preservation would not be expected in the westernmost part of the CPA where sedimentation rates are slower. In the Western Gulf, preservation potential is expected to be moderate to high throughout the area.

High concentrations of shipwrecks in the Eastern Gulf occur offshore from Pensacola and the Apalachicola-Cape San Blas areas. In general, higher numbers of shipwrecks were reported throughout the planning area than were previously realized (Garrison et al., 1989). The major factors that would affect the integrity of wreck sites in the Eastern Gulf are the broad, gently sloping shelf; the relatively low wave energy; and the carbonate sands on the seafloor. Ships that sank in this area are not considered to have a high potential for preservation because of the low sedimentation rates that occur here. Shipwrecks would be exposed on the seabed to decay and deterioration in the oxygenated bottom waters and to strong currents from the occasional tropical storm that traverses the area. Exceptions to this low-preservation potential would be in localized coastal areas where active sand deposition was occurring. Although little data currently exist to test this hypothesis, it is reasonable to expect that much of the Eastern Gulf area is characterized by poor preservation of historic shipwrecks.

Required remote-sensing surveys on the OCS have recorded evidence of approximately 57 potential wrecks. Ten of these are definite wrecks while the remaining 47 would require further investigation for positive identification. Eighty percent of these possible wrecks were recorded within Zone 1, which, according to the baseline study, is where the highest incidence of shipwrecks should occur.

b. Prehistoric

From the late Wisconsin maximum low sea stand (approximately 18,000 B.P.) until sea level reached its current high stand (approximately 5,000 to 3,000 B.P.), the OCS was subaerially exposed and inhabitable by terrestrial flora and fauna--including prehistoric man, who is known to have been in the Gulf Coast region since about 12,000 B.P. According to the sea-level curve proposed for the northern Gulf by Coastal

Environments, Inc. (CEI, 1982), sea level at 12,000 B.P. would have been approximately 45 m below present sea level. Therefore, the continental shelf shoreward of the 45-m bathymetric contour (Archaeological Resource Zones 1 and 2) would have potential for prehistoric sites dating subsequent to 12,000 B.P. Further, since prehistoric sites generally occur in predictable geographic areas, it was proposed in the CEI study that the areas where sites of a given period occur on land will also be the same areas where sites will occur on the now-submerged shelf. Remote-sensing surveys, which have been required on leases shoreward of the 45-m contour, have been very successful in identifying the geographic features that have a high probability for associated prehistoric sites.

Regional geologic mapping studies by MMS provide a geologic framework to aid in the interpretation of lease block survey data. This regional framework allows interpretations to go beyond a statement that a relict feature occurs to an assessment of its archaeological potential in terms of its general age, the type of system to which it belongs, and the geologic processes by which it was formed and modified.

In addition to identifying areas with a high probability for site occurrence, the potential for site preservation must also be considered as an integral part of the predictive model. In general, it may be expected that sites covered by sediments in a low-energy environment (i.e., floodplains, bays, lagoons, river terraces, and subsiding deltas) prior to the sea's transgression of the area will have a high degree of preservation. Other protected areas (i.e., depressions, ponds, lakes, and sinkholes) and areas subjected only to low wave energy also would be conducive to site preservation. Sites on relatively steep shelves that were transgressed during periods of rapid rise in sea level may also have better potential for preservation due to the shorter period of time during which sites would have been exposed to shorefront erosion.

Although many specific areas in the Gulf have been identified through lease-block surveys as having a high potential for prehistoric sites, these high-probability areas generally have been avoided by oil and gas development rather than investigated.

Central Gulf of Mexico

Geographic features that have a high probability for associated prehistoric sites in the Central Gulf include barrier islands and backbarrier embayments, river channels and associated floodplains and terraces, and salt-dome features.

The eastern portion of the CPA is characterized by Holocene deltaic deposits of the Mississippi River, ranging from several hundred feet thick to only a thin veneer. Subaerially developed natural levee ridges, delta front barrier islands, bays, and lagoons are abundant in this area. Sites around bays and lagoons would have a high probability for preservation, while natural levee sites may be preserved under the right conditions. Sites associated with relict, delta-front barrier islands probably would be extensively reworked and incorporated into the relict barrier-island sands. The thickness of archaeologically sterile open-shelf Holocene marine sediments in some areas (generally closer to the active Mississippi Delta) may preclude recovery of site information in the underlying strata.

The western portion of the CPA is generally devoid of Holocene sediments, except in the extreme western portion where localized concentrations of transgressive Holocene sands reach thicknesses up to 7 m (USDI, MMS, 1984b). Many large, late Pleistocene fluvial systems are within a few feet of the seafloor in this area; an excellent example is provided by the ancient Sabine-Calcasieu River Valley. This ancient river valley was extensively studied and mapped by Nelson and Bray (1970) using borehole and seismic data. A study funded by MMS to locate prehistoric archaeological sites in association with the buried Sabine-Calcasieu River Valley has been completed recently (CEI, 1986). Five types of relict landforms, including valley margins/floodplains, terraces, natural levee ridges, point bars, and bay/estuary margins, were identified in association with this buried river valley. These landforms were further evaluated for potential archaeological deposits through the collection of original seismic data. Based on these data, vibracores were collected to evaluate areas of potential archaeological deposits. The final phase of this study attempted site identification through laboratory analysis of the core material. These sedimentary analyses suggest the presence of at least two archaeological sites at the locations tested (CEI, 1986). Lease-block surveys from other areas have recorded evidence of numerous relict late Pleistocene fluvial systems ranging from 100 m across with a maximum cut of 2-3 m, up to 1 km across with maximum cuts of over 30 m. Evidence of floodplains, terracing, and point-bar deposits have been recorded in association with many of these fluvial systems. Sites located along floodplains and terraces, and within point-bar deposits would be expected to have a higher potential for preservation than those sites located along the unprotected outer valley margins; however, these sites may also be preserved under the right conditions. Several examples of salt domes with bathymetric expression have also been recorded during lease-block surveys in this area. Preservation of site materials associated with salt domes would be good within solution depressions and possibly in protected areas of rock outcrops associated with the salt dome. Due to the proximity of most of these relict landforms to the seafloor, the potential for further investigation and data recovery from these sites would be excellent.

Western Gulf of Mexico

The Western Gulf includes the same geomorphic features associated with prehistoric sites as occur in the Central Gulf. The western portion of the WPA is characterized by Holocene deltaic deposits of the Colorado and Brazos Rivers. According to a geologic map series produced by the MMS Office of Marine Geology at Corpus Christi, Texas, the Holocene sediments west of the 96°W longitude range from approximately 4 to 44 m thick (Berryhill and Trippett, 1981). Data from lease-block surveys in this area indicate that these Holocene sediments begin thinning east of the 96°W longitude. Subaerially developed natural levee ridges, delta-front barrier islands, bays, lagoons, and salt domes with bathymetric expression have been recorded as a result of lease-block surveys in this area. Sites around bays and lagoons would have a high probability for preservation, while natural levee sites may be preserved under the right conditions. Sites associated with relict, delta-front barrier islands probably would be extensively reworked and incorporated into the relict, barrier-island sands. The probability of preservation of site materials associated with salt domes would be good within solution depressions and possibly in protected areas of rock outcrops associated with the salt dome. The thickness of archaeologically sterile open-shelf Holocene marine sediments in some areas may prelude recovery of site information in the underlying strata.

The geologic conditions that affect prehistoric-site occurrence and preservation in the easternmost part of the WPA are similar to those that were described above for the adjacent western part of the CPA. In this part of the WPA, McFaddin Beach has produced late Pleistocene megafaunal remains and lithics from all archaeological periods.

Eastern Gulf of Mexico

Geographic features that have a high probability for associated prehistoric sites in the Eastern Gulf include relict barrier islands with back-barrier bays and lagoons, karst topography, and possibly coastal dune lakes. Across much of the Eastern Gulf, the shelf geomorphology is well preserved.

In the western portion of this planning area, off Alabama and the west Florida panhandle, wave energy is relatively high. Off the central and southern Florida coast, wave energy is exceptionally low. In general, Holocene sediments range from a thin veneer to totally absent and consist primarily of carbonate sands.

There would be a high probability for the occurrence of prehistoric sites in association with the relict geomorphic features mentioned above. Preservation of site materials would be very good in karst areas and in the areas of low wave energy. Recovery of site information would be facilitated by the generally thin sequence of Holocene sediments across the Eastern Gulf.

SECTION IV

ENVIRONMENTAL CONSEQUENCES

IV

IV. ENVIRONMENTAL CONSEQUENCES

A. DEVELOPMENT SCENARIO AND EXPLORATION, PRODUCTION, AND TRANSPORTATION ASSUMPTIONS FOR THE PROPOSED ACTIONS

The Gulf of Mexico OCS Region has formulated development scenarios to provide a framework for detailed analyses of potential impacts of proposed OCS oil and gas lease sales in the CPA, WPA, and EPA (Sales 131, 135, and 137, respectively; Figure IV-1). Each of the scenarios is a hypothetical framework of assumptions and estimates on the amounts, timing, and general locations for OCS exploration, development, and production activities and facilities, both offshore and onshore. Because each of them necessarily presents only approximate conditions that might be associated with a sale, the scenarios cannot be used to predict future oil and gas activities. These activities are unpredictable prior to a sale; they do not become clear until offshore and onshore development proceeds from lease through production. For example, factors such as the contemporary economic marketplace and available support facilities and pipeline capacities at the time of future infrastructure development are all unknowns. Notwithstanding these unpredictable factors, the scenarios represent best assumptions and estimates on a set of future conditions that are considered reasonably foreseeable and suitable for presale impact analyses.

It should also be noted that these development scenarios do not represent an MMS recommendation, preference, or endorsement of any level of leasing or offshore operations or of the types, numbers, and/or locations of any onshore operations or facilities.

1. Resource Estimates

The Base Case and High Case described in this section are used to assess the sale-specific impacts of the proposed actions. These scenarios are based on recent trends in the following factors:

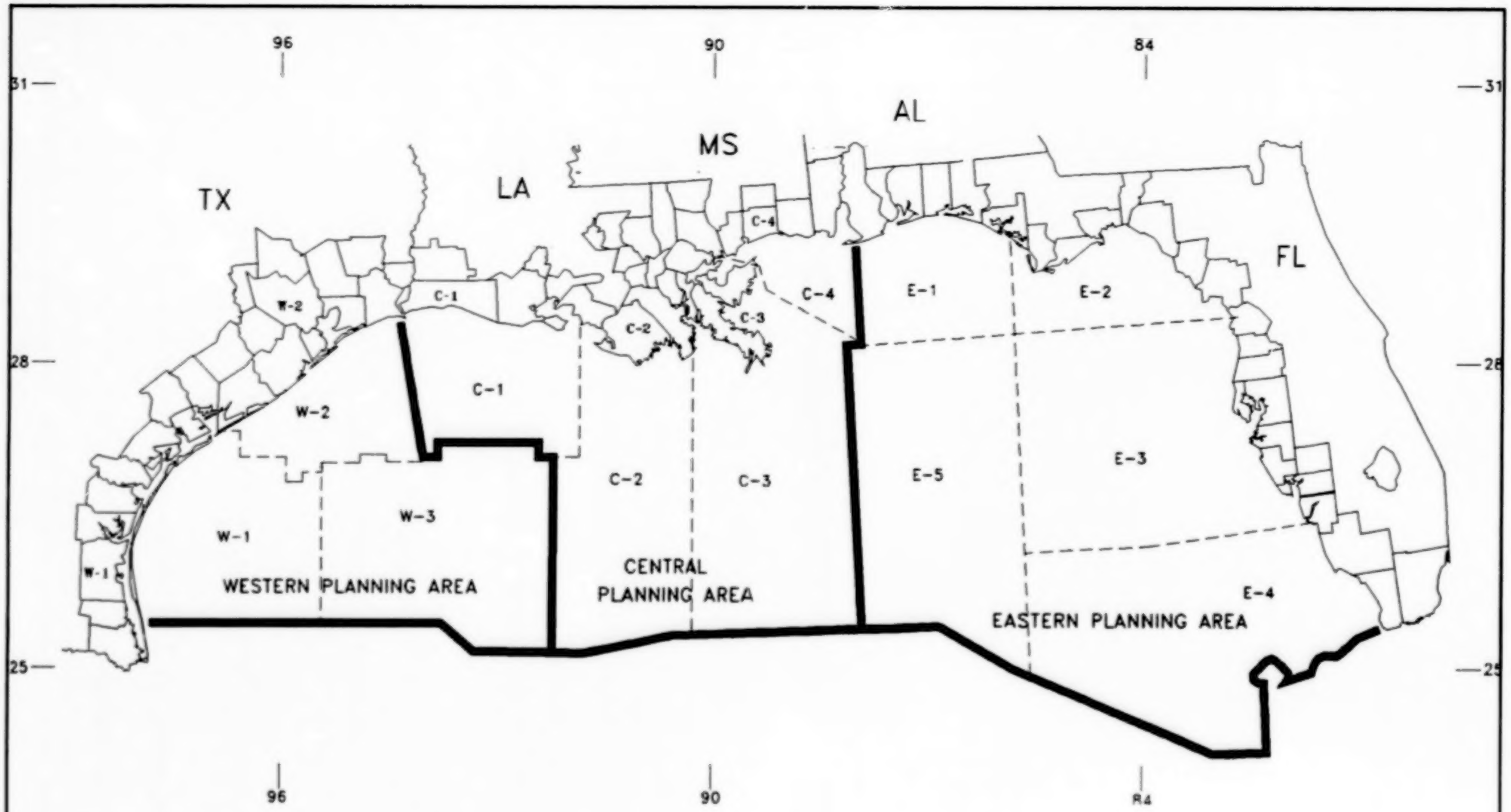
- the amount and location of leasing, exploration, and development activity;
- existing offshore and onshore oil and/or gas infrastructure;
- industry-practice information;
- oil and gas technologies, and the economic considerations and environmental constraints of these technologies; and
- the estimates of undiscovered, unleased oil and gas resources in the planning areas.

The resource estimates used for the Base and High Cases are based on two factors: (a) the conditional estimates of undiscovered, unleased oil and gas resources in the planning area; and (b) estimates of the portion or percentage of these resources assumed to be discovered, developed, and produced as a result of the proposed actions. The resource estimates for the Base and High Cases differ as follows: the Base Case estimates are based on the mean or "expected" case values of total undiscovered, unleased resources; the High Case estimates, which are based on the high or 5 percent values, correspond to a 5 percent chance of that amount or more occurring.

The Base Cases--because they are based on the mean or "expected" resource estimates--are used for the principal impact analyses of the proposed sales, including the cumulative analyses. The High Cases are used to provide a supplementary analysis of the effects that could occur if a greater, though much less likely, amount of resources were discovered and developed. Tables IV-1 through IV-3 provide a summary of major elements of the Base and High Cases and some of the related impact-producing factors for each proposed action.

2. Exploration, Development, and Production Estimates and Timetables

Central Gulf Sale 131: This proposed action offers for lease all unleased blocks in the CPA. As of June 1990, there were 5,204 unleased blocks containing approximately 28.1 million acres in the CPA. The actual number of blocks offered for lease may differ from the June 1990 figure by the number of blocks relinquished, canceled, and/or terminated.



WESTERN COASTAL AREA
W-1
Aransas, Calhoun, Cameron, Jackson, Kenedy, Kleberg, Nueces, San Patricio, Refugio, Victoria, Willacy

WESTERN COASTAL AREA
W-2
Brazoria, Chambers, Fort Bend, Galveston, Hardin, Harris, Jefferson, Liberty, Matagorda, Montgomery, Orange, Waller, Wharton

CENTRAL COASTAL AREA
C-1
Cameron, Calcasieu, Iberia, Lafayette, Vermilion
C-2
Ascension, East Baton Rouge, Lafourche, Livingston, St. Charles, St. James, St. Mary, St. John the Baptist, Tangipahoa, Terrebonne, West Baton Rouge

CENTRAL COASTAL AREA
C-3
Jefferson, Orleans, Plaquemines, St. Bernard, St. Tammany
C-4
Baldwin, Hancock, Harrison, Jackson, Mobile, Stone

EASTERN COASTAL AREA
E-1
Escambia, Santa Rosa,Okaloosa,Walton,Bay
E-2
Gulf ,Franklin,Wakulla ,Jefferson,Taylor, Dixie,Levy
E-3
Citrus,Hernando,Pasco,Pinellas,Hillsborough, Manatee, Sarasota,Charlotte,Lee,Collier
E-4
Monroe,Dade

Figure IV-1. Gulf of Mexico OCS Region Planning and Analysis Areas.

Table IV-1

Summary of Existing Gulf of Mexico OCS-related Impact-producing Factors and Factors Projected Over the Life of the Proposed Sale (1991-2029) (Central Gulf of Mexico)

	Total to Date	1988 Annual	Projected (total/peak year)		
			Sale 131 (Base Case)	All OCS Sales	Sale 131 (High Case)
Reserve/Resource Production					
Oil (Bbbls)	7.561 /	0.263	0.13 / 0.006	6.41 / 0.279	0.24 / 0.012
Gas (tcf)	72.979 /	3.241	1.21 / 0.058	54.71 / 2.35	2.24 / 0.108
Exploration and Delineation Wells	NA /	372	310 / 70	4,600 / 280	470 / 70
Platform Installations	3,285 /	139	25 / 3	265 / 19	30 / 3
Development Wells	NA /	327	230 / 15	4,980 / 310	400 / 25
Pipeline Length (km)	26,341 /	534	201 / 24	5,951 / 935	241 / 24
Method of Oil Transportation					
Percent Piped	NA /	98.0	96.7 / NA	96.9 / NA	96.8 / NA
Percent Barged	NA /	2.0	3.0 / NA	3.0 / NA	3.0 / NA
Percent Tankered	NA /	0.0	0.3 / NA	0.1 / NA	0.2 / NA
Shuttle Tanker Traffic (trips)	0 /	0	3 / 1	48 / 2	4 / 1
Barge Traffic (trips)	7,561 /	263	195 / 9	9,615 / 419	360 / 18
Service Vessel Traffic (1,000 trips)	760 /	19	15 / 1	219 / 9	22 / 2
Discharges					
Drilling Muds (1,000 bbls)	167,836 /	3,180	2,457 / 387	43,589 / 2,685	3,959 / 432
Drill Cuttings (1,000 yds^3)	18,849 /	357	276 / 43	4,895 / 301	445 / 49
Produced Waters (MMbbls)					
Discharged Onshore	24,033 /	841	413 / 19	20,328 / 885	762 / 38
Discharged Offshore	40,922 /	1431	703 / 32	34,613 / 1506	1,298 / 65
Pipeline-disturbed Sediments (MMyds^3)	158.0 /	3.2	1.2 / 0.1	35.7 / 5.6	1.4 / 0.1
Air Emissions (1,000 tons)					
Nitrogen Oxide	NA /	NA	7.499 / 0.431	209.513 / 5.372	11.224 / 0.647
Carbon Monoxide	NA /	NA	1.064 / 0.062	28.901 / 0.741	1.602 / 0.093
Sulfur Oxide	NA /	NA	0.362 / 0.025	6.792 / 0.174	0.584 / 0.039
Volatile Organic Compounds	NA /	NA	0.989 / 0.033	45.338 / 1.162	1.23 / 0.05
Total Suspended Particulates	NA /	NA	0.005 / 0	0.274 / 0.007	0.006 / 0

NA - Denotes that the data/estimate is not available.

Source: USDI, Minerals Management Service, Gulf of Mexico OCS Region, 1989.

Table IV-2

Summary of Existing Gulf of Mexico OCS-related Impact-producing Factors and Factors Projected Over the Life of the Proposed Sale (1991-2029) (Western Gulf of Mexico)

	Total to Date	1988 Annual	Projected (total/peak year)		
			Sale 135 (Base Case)	All OCS Sales	Sale 135 (High Case)
Reserve/Resource Production					
Oil (Bbbls)	0.208 /	0.026	0.05 / 0.002	1.21 / 0.046	0.11 / 0.005
Gas (tcf)	10.44 /	1.238	0.72 / 0.035	25.67 / 1.017	1.56 / 0.075
Exploration and Delineation Wells	NA /	222	200 / 45	3,480 / 235	290 / 70
Platform Installations	365 /	15	15 / 2	165 / 10	30 / 3
Development Wells	NA /	48	110 / 5	1,980 / 95	220 / 15
Pipeline Length (km)	4,322 /	190	121 / 16	5,026 / 798	241 / 24
Method of Oil Transportation					
Percent Piped	NA /	98.0	78.8 / NA	86.5 / NA	78.8 / NA
Percent Barged	NA /	2.0	3.0 / NA	3.0 / NA	3.0 / NA
Percent Tankered	NA /	0.0	18.2 / NA	10.5 / NA	18.2 / NA
Shuttle Tanker Traffic (trips)	0 /	0	68 / 3	955 / 36	151 / 7
Barge Traffic (trips)	208 /	26	75 / 3	1,815 / 69	165 / 7
Service Vessel Traffic (1,000 trips)	103 /	5	9 / 1	128 / 5	15 / 1
Discharges					
Drilling Muds (1,000 bbls)	23,478 /	1,229	1,411 / 228	24,843 / 1,502	2,321 / 387
Drill Cuttings (1,000 yds^3)	2,637 /	138	158 / 26	2,790 / 169	261 / 43
Produced Waters (MMbbls)					
Discharged Offshore	1,936 /	241	433 / 17	10,643 / 405	954 / 43
Pipeline-Disturbed Sediments (MMyds^3)	25.9 /	1.1	0.7 / 0.1	30.2 / 4.8	1.4 / 0.1
Air Emissions (1,000 tons)					
Nitrogen Oxide	NA /	NA	4.376 / 0.293	85.719 / 2.198	11.995 / 0.416
Carbon Monoxide	NA /	NA	0.620 / 0.042	12.083 / 0.31	1.075 / 0.059
Sulfur Oxide	NA /	NA	0.209 / 0.017	3.812 / 0.098	0.342 / 0.023
Volatile Organic Compounds	NA /	NA	0.589 / 0.021	13.065 / 0.335	1.141 / 0.036
Total Suspended Particulates	NA /	NA	0.003 / 0	0.073 / 0.002	0.006 / 0

NA - Denotes that the data/estimate is not available.

Source: USDI, Minerals Management Service, Gulf of Mexico OCS Region, 1989.

Table IV-3

Summary of Existing Gulf of Mexico OCS-related Impact-producing Factors
and Factors Projected Over the Life of the Proposed Sale (1991-2029)
(Eastern Gulf of Mexico)

	Total to Date	1988 Annual	Projected (total/peak year)		
			Sale 137 (Base Case)	All OCS Sales	Sale 137 (High Case)
Reserve/Resource Production					
Oil (Bbbls)	0 /	0	0.04 / 0.002	0.37 / 0.015	0.09 / 0.004
Gas (tcf)	0 /	0	0.06 / 0.003	0.82 / 0.033	0.08 / 0.004
Exploration and Delineation Wells	39 /	1	90 / 15	680 / 38	130 / 25
Platform Installations	0 /	0	10 / 1	55 / 4	15 / 1
Development Wells	0 /	0	50 / 3	430 / 17	90 / 5
Pipeline Length (km)	0 /	0	80 / 8	1,387 / 364	121 / 8
Method of Oil Transportation					
Percent Piped	NA /	0.0	17.4 / NA	6.7 / NA	17.4 / NA
Percent Barged	NA /	0.0	0.0 / NA	0.0 / NA	0.0 / NA
Percent Tankered	NA /	0.0	82.6 / NA	93.3 / NA	82.6 / NA
Shuttle Tanker Traffic (trips)	0 /	0	99 / 5	1,037 / 42	223 / 10
Barge Traffic (trips)	0 /	0	0 / 0	0 / 0	0 / 0
Service Vessel Traffic (1,000 trips)	1 /	1	5 / 1	30 / 1	7 / 1
Discharges					
Drilling Muds (1,000 bbls)	177 /	5	637 / 82	5,051 / 250	1,001 / 137
Drill Cuttings (1,000 yds^3)	20 /	1	72 / 9	567 / 28	112 / 15
Produced Waters (MMbbls)					
Discharged Offshore	0 /	0	338 / 17	3,130 / 127	759 / 33
Pipeline-Disturbed Sediments (MMyds^3)	0.0 /	0.0	0.5 / 0.0	8.3 / 2.2	0.7 / 0.0
Air Emissions (1,000 tons)					
Nitrogen Oxide	NA /	NA	0.857 / 0.158	14.708 / 0.377	3.5 / 0.158
Carbon Monoxide	NA /	NA	0.111 / 0.022	2.08 / 0.053	0.492 / 0.022
Sulfur Oxide	NA /	NA	0.001 / 0.009	0.678 / 0.017	0.15 / 0.009
Volatile Organic Compounds	NA /	NA	0.325 / 0.012	2.117 / 0.054	0.56 / 0.012
Total Suspended Particulates	NA /	NA	0.002 / 0	0.012 / 0	0.003 / 0

NA - Denotes that the data/estimate is not available.

Source: USDI, Minerals Management Service, Gulf of Mexico OCS Region, 1989.

The estimated amounts of oil and gas resources expected to be developed--as well as the total number of exploration and delineation wells, production platforms, and development wells, and the total miles of offshore pipeline needed to discover, develop, and produce the estimated resources--are included in Table IV-1 for the Base and High Cases. This table also includes estimates of the major impact-producing factors or agents related to the estimated levels of exploration, development, and production activity. See Table IV-4 for disaggregations of these factors to the various offshore subareas in the CPA and Figure IV-1 for the location of the four planning subareas in the Central Gulf.

Under the Base and High Cases, exploratory activity takes place over a 10-year period (1992-2001). The most intense level of activity occurs from 1995-1996 in the Base Case and during 1997 in the High Case; development activity begins in 1993 with the installation of the first production platform and ends in 2018 with the drilling of the last development wells; and production of oil and gas takes place over the 1993-2024 period.

Western Gulf Sale 135: This proposed action offers for lease all unleased blocks in the WPA with the exception of two unique and highly sensitive blocks in the Flower Garden Banks (Blocks A-398 and A-375 in the High Island, East Addition, South Extension Area) that have been deferred. Excluding these two deferred blocks, as of May 1990 there were 4,792 unleased blocks containing approximately 26.3 million acres in the WPA. The actual number of blocks offered for lease may differ from the May 1990 figure by the number of blocks relinquished, canceled, and/or terminated, less the number of blocks leased during the intervening period.

The estimated amounts of oil and gas resources expected to be developed--as well as the total number of exploration and delineation wells, production platforms, and development wells, and the total miles of offshore pipeline needed to discover, develop, and produce the estimated resources--are included in Table IV-2 for the Base and High Cases. This table also includes estimates of major impact-producing factors or agents related to the estimated levels of exploration, development, and production activity. See Table IV-4 for disaggregations of these factors to the various offshore subareas in the WPA and Figure IV-1 for the location of the three planning subareas in the Western Gulf.

Under the Base Case, exploratory activity takes place over a 10-year period (1992-2001). The most intense level of activity occurring from 1995-1996, development activity begins in 1993 with the installation of the first production platform and ends in 2014 with the drilling of the last development wells, and production of oil and gas takes place over the 1993-2024 period. Under the High Case, exploratory activity takes place over a 10-year period (1992-2001). Development activity begins in 1993 and ends in 2018, and production of oil and gas extends through 2024.

Eastern Gulf Sale 137: This proposed action offers for lease all unleased blocks in the EPA with the exception of three regions that have been deferred because they contain environmentally sensitive biological communities. Excluded from the proposed sale is the area approximately 32-48 km (20-30 mi) seaward of the western coastline of Florida that extends from the Apalachicola/Cape San Blas area on the north to latitude 26°N to the south, as well as 23 blocks centered around the Florida Middle Ground (both deferred at the time of the 5-Year Program Decision), and the region south of latitude 26°N to the State waters north of the Keys and west to approximately longitude 86°W. Excluding the two deferred blocks, as of June 1990 there were 8,356 unleased blocks comprising approximately 47.5 million acres in the EPA. The actual number of blocks offered for lease may differ from the June 1990 figure by the number of blocks relinquished, canceled, and/or terminated, less the number of blocks leased during the intervening period.

The estimated amounts of oil and gas resources expected to be developed--as well as the total number of exploration and delineation wells, production platforms, and development wells, and the total miles of offshore pipeline needed to discover, develop, and produce the estimated resources--are included in Table IV-3 for the Base and High Cases. This table also includes estimates of major impact-producing factors or agents related to the estimated levels of exploration, development, and production activity. See Table IV-4 for disaggregations of these factors to the various offshore subareas in the EPA and Figure IV-1 for the location of the five planning subareas in the Eastern Gulf.

Under the Base Case, exploratory activity takes place over a 7-year period (1995-2001), development activity begins in 1998 with the installation of the first production platform and ends in 2020 with the drilling of the last development well, and production of oil and gas takes place over the 1998-2029 period. Under the High Case, exploratory activity takes place over an 8-year period (1995-2002), development activity begins in 1998 and ends in 2021, and production of oil and gas extends through 2029.

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Table IV-4

Projected Impact-producing Factors Over the Life of the Proposed Sales (1991-2029) by Offshore Subplanning Area* (Base Case and High Case)

Central Gulf Sale 131 - Offshore Subplanning Area

	C-1		C-2		C-3		C-4		Total Central	
Offshore (total/peak year)	Base Case	High Case	Base Case	High Case	Base Case	High Case	Base Case	High Case	Base Case	High Case
Exploration and Delineation Wells	9 / 2	14 / 2	202 / 45	305 / 45	96 / 22	146 / 22	3 / 1	5 / 1	310 / 70	470 / 70
Platform Installations	1 / 0	1 / 0	16 / 2	20 / 2	8 / 1	9 / 1	0 / 0	0 / 0	25 / 3	30 / 3
Development Wells	7 / 0	12 / 1	150 / 10	260 / 16	71 / 5	124 / 8	2 / 0	4 / 0	230 / 15	400 / 25
Pipeline Length (km)	6.0 / 0.7	7.2 / 0.7	130.7 / 15.7	156.7 / 15.7	62.3 / 7.4	74.7 / 7.4	2.0 / 0.2	2.4 / 0.2	201 / 24	241 / 24
Shuttle Tanker Traffic (trips)	0 / 0	0 / 0	0 / 0	0 / 0	3 / 1	4 / 1	0 / 0	0 / 0	3 / 1	4 / 1
Barge Traffic (trips)	17 / 1	32 / 3	0 / 0	0 / 0	172 / 8	317 / 15	6 / 0	11 / 0	195 / 9	360 / 18
Service Vessel Traffic (1,000 trips)	0.45 / 0.03	0.66 / 0.06	9.75 / 0.65	14.30 / 1.30	4.65 / 0.31	6.82 / 0.62	0.15 / 0.01	0.22 / 0.02	15 / 1	22 / 2

Western Gulf Sale 135 - Offshore Subplanning Area

	W-1		W-2		W-3		Total Western	
Offshore (total/peak year)	Base Case	High Case	Base Case	High Case	Base Case	High Case	Base Case	High Case
Exploration and Delineation Wells	72 / 16	104 / 25	14 / 3	20 / 5	114 / 26	166 / 40	200 / 45	290 / 70
Platform Installations	5 / 1	11 / 1	1 / 0	2 / 0	9 / 1	17 / 2	15 / 2	30 / 3
Development Wells	40 / 2	79 / 5	8 / 0	15 / 1	62 / 3	126 / 9	110 / 5	220 / 15
Pipeline Length (km)	43.6 / 5.8	86.8 / 8.6	8.5 / 1.1	16.9 / 1.7	68.9 / 9.1	137.3 / 13.7	121 / 16	241 / 24
Shuttle Tanker Traffic (trips)	40 / 2	90 / 4	0 / 0	0 / 0	28 / 1	61 / 3	68 / 3	151 / 7
Barge Traffic (trips)	63 / 3	137 / 6	12 / 0	28 / 1	0 / 0	0 / 0	75 / 3	165 / 7
Service Vessel Traffic (1,000 trips)	3.24 / 0.36	5.40 / 0.36	0.63 / 0.07	1.05 / 0.07	5.13 / 0.57	8.55 / 0.57	9 / 1	15 / 1

Eastern Gulf Sale 137 - Offshore Subplanning Area

	E-1		E-2		E-3		E-4		Total Eastern	
Offshore (total/peak year)	Base Case	High Case	Base Case	High Case	Base Case	High Case	Base Case	High Case	Base Case	High Case
Exploration and Delineation Wells	32 / 5	40 / 8	6 / 1	9 / 2	52 / 9	81 / 15	0 / 0	0 / 0	90 / 15	130 / 25
Platform Installations	4 / 0	5 / 0	1 / 0	1 / 0	5 / 1	9 / 1	0 / 0	0 / 0	10 / 1	15 / 1
Development Wells	18 / 1	28 / 2	4 / 0	6 / 0	28 / 2	56 / 3	0 / 0	0 / 0	50 / 3	90 / 5
Pipeline Length (km)	28.8 / 2.9	37.5 / 2.5	5.6 / 0.6	8.5 / 0.6	45.6 / 4.5	75.0 / 4.9	0.0 / 0.0	0.0 / 0.0	80 / 8	121 / 8
Shuttle Tanker Traffic (trips)	6 / 0	12 / 0	8 / 1	19 / 1	85 / 4	192 / 9	0 / 0	0 / 0	99 / 5	223 / 10
Barge Traffic (trips)	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
Service Vessel Traffic (1,000 trips)	1.80 / 0.36	2.17 / 0.31	0.35 / 0.07	0.49 /0.07	2.85 / 0.57	4.34 / 0.62	0.00 / 0.00	0.00 /0.00	5 / 1	7 / 1

*Shown on Figure IV-1.

Source: USDI, Minerals Management Service, Gulf of Mexico OCS Region, 1989.

3. Offshore Infrastructure

a. Existing Infrastructure

Existing offshore infrastructure related to the oil and gas industry is highly concentrated in the Central and Western Gulf of Mexico. To this date, only OCS exploration activities have taken place in the Eastern Gulf of Mexico. A summary of existing offshore infrastructure and associated impact-producing factors can be found in Tables IV-1, IV-2, and IV-3 for the CPA, WPA, and EPA, respectively. These tables provide estimates of exploration and delineation wells, platform installations, development wells, and offshore pipeline length existing to date, as well as installed/developed in 1988.

b. Drilling Rigs and Platforms

(1) Emplacement Operations

(a) Geohazardous Conditions

Within the Gulf of Mexico, major geohazards to oil and gas development are associated with geologic features on the seafloor that result in its instability. These hazards present many operational limitations to the exploration and development of oil and gas. Seafloor instabilities present limitations and necessitate adaptations in the siting and structural engineering of pipelines, drilling rigs, and production platforms. Three conditions prevail that cause unstable conditions on the seafloor in the Gulf of Mexico: (1) salt movement, which may result in salt domes, faults, steep slopes, gas seepage, and sediment slumping; (2) sediment overloading and differential compaction causes growth faults and differential subsidence; and (3) rapid sedimentation in deltaic areas, which results in unconsolidated, fine-grained, often gas-charged sediments.

Most structures and equipment used for minerals exploration and development can be designed to withstand the stresses of the continental shelf environment if adequate information is available. Studies developed under the former BLM (now MMS) Environmental Studies Program have been especially directed toward areas where more detailed geologic information was needed for informed management of the OCS minerals leasing program. Visual No. 4 shows the areas where geologic studies have provided detailed information for mapping.

Under the schedule for oil and gas leasing, the offering of all blocks within the Gulf of Mexico OCS does not include making the presale geohazard block evaluations that were done previously. Instead, the Secretary of the Interior has announced that geohazard surveys and evaluations will be done by industry. The Regional Director (RD) of the MMS, Gulf of Mexico OCS Region notifies the operator of the lease through Notice to Lessee (NTL) 83-3, *Shallow Hazards Requirements for the Gulf of Mexico OCS Region*, which is issued by MMS, that conditions may exist such that precautions in site selection and design must be taken. Industry then is responsible for interpreting sites in detail and for furnishing the RD with the results of surveys for the blocks leased within the geohazardous areas. Subsequently, industry must indicate to the RD how plans of exploration and development minimize and/or avoid the geohazards that exist within the lease area. Geological and geophysical (G&G) activities, which provide data on potential geological and manmade hazards, must be conducted so that the activities permitted do not create hazardous or unsafe conditions. G&G activities for areas not under lease are authorized under 30 CFR 251; G&G activities on leased acreage are under 30 CFR 250). Geophysical surveys conducted on a lease must be conducted in compliance with NTL 83-3. Before the installation of any structure or pipeline, the grantee shall conduct a shallow-hazards analysis in the immediate area of the proposed activity to locate, identify, and assess the potential geologic hazards and engineering constraints that may be present.

In essence, a shallow-hazards analysis shall include the following:

- An assessment of any seafloor and subsurface geologic and manmade features and conditions that may adversely effect the proposed operations. Seafloor geologic hazards include fault scarps, gas vents, unstable slopes, and reefs. Subsurface geologic hazards include faults, gas-charged sediments, abnormal pressure zones, and buried channels. Manmade hazards include pipelines, wellheads, shipwrecks, ordnances, communication cables, and debris from previous oil and gas activities.

- A specific discussion of sediment mass movement, unstable slopes, active faulting, or gaseous sediments when required by the special operational constraints on some leases.

- A discussion of any special safety measures that would minimize the effects of shallow hazards on the proposed pipeline including a discussion of how compliance with the provisions of NTL 83-3, section IV, paragraph B, will be accomplished.

The postsale regulatory authority of MMS requires the lessee is required to obtain detailed, site-specific geologic-hazards information (including soils borings in special cases) at locations on leased blocks where pipeline development is proposed. This requirement is imposed on all lessees to assure safety of operations before approval of pipeline permits. The extent and degree of geologic-hazards investigation required of the lessee is at the discretion of the RD, Gulf of Mexico OCS Region, who is charged with approval of the safety of OCS operations in this region. The general procedures to be followed by the lessee in conducting the site-specific geologic-hazards survey are set forth in NTL 83-3. The NTL and applicable LTL's serve as guidance for minimum requirements and in no way restrict the authority of the RD to impose additional requirements on the lessee when necessary. As a result of revised regulations (effective May 31, 1988) contained in 30 CFR 250, MMS is revising NTL 83-3.

(b) Ordnance Hazards

The Department of Defense (DOD) explosives dumping areas are found in the Gulf planning areas. Most of the areas are small and contain a single, undetonated depth charge. For the larger areas, dumping consisted of old ordnance and unexploded (duds) shells and depth charges. Although dumping has not taken place in any of the explosive areas since 1969-1970, all lessees should take precautions in drilling and locating structures within or near these areas because of the presence of unexploded ordnances. Additionally, the U.S. Air Force (USAF) has released an indeterminable amount of unexploded ordnances in water test areas 1 and 3 as a result of testing and training missions. The exact locations of this unexploded ordnance cannot be determined, and all lessees in the Gulf should take precautions in drilling or locating structures due to the potential hazards. In past sales this warning has been provided to each lessee in an ITL.

(2) Physical Presence of Drilling Rigs, Platforms, Boats, and Barges

The exploration, development, and production of OCS resources consist of many phases of activity including pre- and postlease geophysical and geological surveys made with medium- to small-size vessels, the placement of exploratory rigs, support from local bases using crew and work boats, the placement of platforms for long-term use, the use of barges and work boats in support of production activities, and transmission by pipeline or barge of production to shore. All these activities affect their surroundings merely because of their presence in the area.

An increase in ship or boat traffic in an area may or may not have an impact on the area depending on existing conditions. It is possible, however, that any increase in vessel traffic could pose additional transportation safety hazards in an area that is heavily traveled or particularly difficult to navigate. If existing port and supply facilities are to be used, and if this is the assumption regarding sale activities, increased usage may affect their adequacy to meet all commercial needs. Increased vessel traffic also could increase the potential for collision with living marine resources or other vessels and users of the marine environment.

The presence of offshore rigs and platforms occasionally conflicts with commercial and sport fishing interest for space. However, this is often offset by the fish-attracting capabilities of the structures. Commercial trawling would be most affected by the presence of offshore structures. If a rig is placed in productive fishing grounds, commercial fishermen would be required to assume the burden of safe navigation around these obstacles without entangling their gear.

All platforms and rigs are obstacles to local navigation. It is fortunate, however, that these structures are quite visible to mariners due to their size and lighting, and all oil and gas structures placed on the OCS must have aids to navigation installed and maintained in compliance with detailed U.S. Coast Guard regulations (33 CFR 67).

At a distance of 3 mi, platforms and rigs are visible on nearshore Federal leases, although on many days, atmospheric conditions (fog, mist, or low-lying clouds) make all but the closest rigs invisible to the naked eye. Between 12 and 20 mi offshore, oil and gas structures can hardly be seen from the beach, and then only under ideal atmospheric conditions. At this distance, little is visible under normal atmospheric conditions except at night when only the lights on top of the rigs are noticeable. Beyond 20 mi, nothing can be seen from sea level because of the curvature of the earth (USDI, MMS, 1983).

Studies completed by Dornbusch and Company et al. (1987) to determine the degree of association between OCS visual distractions and beach attendance in California (and thus tourism and recreation) indicated ambiguous results. Therefore, they declined to include this variable in their model, which produces detailed quantitative impact results.

Rig and platform emplacement will result in disruption and suspension of sediments only in the immediate vicinity of the site. Displaced material or the physical presence of the rig or platform can smother burrowing and attached benthos. Increased turbidity resulting from rig and platform emplacement can temporarily clog the respiratory organs of many marine organisms and the filter-feeding mechanisms of numerous others. This increased turbidity is a short-term phenomenon and generally is not significant beyond a few hundred meters from the site of the rig, platform, or associated anchors.

(3) Structure Removal

Lessees are required to remove all structures and underwater obstructions from a lease block within 1 year after a lease is relinquished or terminated. In the northern Gulf of Mexico, there are about 3,679 oil/gas offshore platforms and other structures on the Federal OCS and several thousand in State waters. Offshore platforms attract and provide habitats for a variety of marine organisms. Removal of these structures eliminates these habitats and, in the case of explosive removal, could injure or kill these organisms during detonation. Historically, about 55 to 65 of these structures are removed annually from offshore waters. From 1984 through 1988, 59, 69, 59, 22, and 167 structures were removed, respectively. In 1987, approximately 59 percent were removed nonexplosively; this decreased to 25 percent in 1988. As of July 1989, 24 structures had been removed (92% were removed using explosives, 8% using nonexplosive methods).

Bottlenose dolphins and sea turtles have been observed near offshore structures. A discussion of the animals' occurrence across the Gulf of Mexico and an assessment of the potential impacts of structure-removal activities on these animals can be found in a programmatic environmental assessment (USDI, MMS, 1987a). The MMS observers at 17 offshore oil/gas structure removals from November 1986 to June 1988 have sighted 3 sea turtles and 12 bottlenose dolphins. No injuries or mortality of any sea turtles or bottlenose dolphins were observed at any of these structure removals.

Fritts et al. (1983) conducted aerial surveys across a 9,514-mi^2 area in the Central, Western, and Eastern Gulf of Mexico. Results of these surveys indicate that the bottlenose dolphin is by far the most likely marine mammal to be encountered at a proposed structure-removal site.

Definitive information on the possibility of encountering sea turtles during removal operations currently does not exist. However, the preliminary findings of an NMFS study funded by MMS suggest that sea turtles and marine mammals are not consistently associated with oil and gas structures. Habitat may be a more important factor in sea turtle distribution than the presence of structures. Since the possibility exists that sea turtles may be taken by explosive structure-removal operations, a Summary Evaluation is prepared by MMS to initiate with the NMFS a Section 7 consultation under the Endangered Species Act, as amended. The NMFS then prepares a biological opinion and an Incidental Take Statement (ITS). Within the ITS are mitigative measures developed by NMFS to prevent injuries to sea turtles. A copy of a recent NMFS biological opinion pertaining to structure removals is in Appendix B.

(4) Blowouts

During OCS oil and gas operations, blowouts--the loss of well control--are the incidents that are most feared and have the greatest potential for causing deaths, injuries, property damage or loss, and pollution. However, well blowouts and platform or drilling rig losses are rare occurrences during offshore drilling operations.

Gas pressure can be responsible for a well blowout. Very shallow gas may occur in unconsolidated sediments at depths of 100-500 ft below the mud line. Drilling through these shallow gas zones requires extreme caution. A delicate balance between drilling-mud pressure and formation pressure is necessary to prevent an influx of gas into the wellbore and to avoid fracturing the near-surface formations. Shallow gas and formation fracturing are greater potential hazards in deep waters because they are more difficult to keep in proper balance with the ocean water and overburden pressures.

When a well blowout occurs, the loss of control could be momentary--and control could be immediately regained using standard onsite safety equipment and procedures--or it may continue for several days. The duration of blowouts that occurred between 1956 and 1989 ranged from immediate shut-in to 165 days. Of the 157 blowouts that occurred in that time, 28 resulted in the release of oil into the environment. Sixteen of these spills involved less than one barrel of oil. Two of the blowouts resulted in the spillage of over 25,000 bbl (30,000 and 53,000 bbl). Spillage from the remaining blowouts ranged from 10 to 5,180 bbl. The amount of gas escaping during a blowout is difficult to determine. In the Gulf of Mexico, no reported environmental damage was caused by blowouts from 1956 to 1989 with the exception of a blowout that occurred in 1970 and resulted a 53,000-bbl oil spill. Minor amounts of oil were observed on beaches as a result of this accident (USDI, MMS, 1986a and 1987b).

Industrial expertise in safety has increased as industry has advanced drilling technology. The MMS is supporting studies on preventing blowout, blowout fires, and collecting of blowout oil before it disperses into the open ocean. An important factor in ensuring that offshore oil and gas operations are carried out in a manner that emphasizes safety of operations and minimizes the risk of environmental damage is the proper training of personnel in pollution-prevention procedures. The enacted Safety Device Training Program requires all personnel to receive training for installing, testing, inspecting, and operating production, safety, and pollution-prevention equipment. The Drilling Well-Control Training Program instituted by MMS in 1979 requires all personnel involved in offshore drilling activities to be trained in well-control operations and requires periodic refresher courses.

c. Seismic/Exploratory Operations

Direct impact-producing factors that are associated with seismic operations are subsurface impulses and the presence of vessels and associated trailing gear. Seismic operations involve the accurate measurement of the travel time required for an artificially generated seismic (acoustic) wave to travel into the subsurface and return after being reflected or refracted by either unconsolidated sediments or rock layers below the seafloor. Sound sources for seismic operations include electric sparkers, air guns, sleeve exploders, electromechanical devices, and rarely explosives. A frame with an array of air guns is most commonly used.

Sparkers create an acoustic pulse by generating a powerful electric spark between submerged electrodes. Air guns explosively release a charge of high-pressure air into the water. Sleeve exploders ignite a bubble of gas (such as propane) in a manifold (sleeve). High-resolution seismic operations frequently generate their sound pulse by electrically causing two confined metal plates to separate rapidly.

Seismic operations have caused concern from commercial fishing and environmental groups. These concerns are that the surveys are lethal or damaging to fish eggs and larvae, and disturbing to fish and other marine life, and they may also be destructive to commercial fishing gear. Additionally, it may be that seismic surveys conflict physically and spatially with commercial fishing. It is obvious that two users of the same space are sometimes going to come into conflict.

Whales' reactions to seismic activities vary between an immediate response (e.g., flight and startle response) to seemingly no reaction, depending on the proximity of the seismic vessel (Malme et al., 1984). Behaviors in whales are measured by changes in dive duration, surface duration, number of blows per surface, travel direction and speed, calling rate, respiration rate, and other dive characteristics.

Shock waves associated with seismic air guns would not immediately be harmful to marine animals (Geraci and St. Aubin, 1980), although noise may affect behavior. Other information (Dome Petroleum Ltd. et al., 1982) suggests that while seismic and/or vessel noise might temporarily affect hearing, mask vocalizations or sound used to locate prey or predators, or result in temporary displacement, nearby effects on regional populations are likely to be negligible.

For further information on seismic operations and their associated impacts, see *Environmental Assessment for Geological and Geophysical Exploration Activities on the Outer Continental Shelf* (USDI, MMS, 1984c).

d. Transportation Descriptions/Activities

(1) Transportation Assumptions

Transportation of oil to shore processing facilities in the Central and Western Gulf of Mexico historically has relied heavily on an ever-expanding pipeline network. Along with pipeline movement of oil and gas/condensate, there has always been a small percentage of barging operations transporting oil to offloading facilities lcoated at onshore terminals. Tables IV-1 through IV-3 present transportation assumptions for proposed Sales 131/135/137. These tables also provide information on historical oil movement for each planning area. All economically recovered natural gas (100%) is assumed to be piped to shore.

Because of the recent trend to a much higher level of leasing in deep-water blocks not located in proximity to the existing oil-pipeline-transmission system, future shuttle tankering of oil is expected to occur in the CPA and WPA. It was once felt that the limiting factor determining industry's use of tankers versus pipelines was water depth. However, technological developments in recent years have enabled industry to place pipelines in water depths as great as 6,000 ft. Because of these new capabilities, EIS projections of large percentages of tankering have been significantly decreased for Sales 131 and 135. Projections of future use of tankers versus pipelines are based on distance from the existing pipeline network or land, rather than the water depth.

Because there has not been any production of oil and gas in the OCS leasing areas in Florida, it is unclear how oil and gas would be transported to processing centers. Until major finds occur and further information is available, it is hypothesized that shuttle tankers will transport all oil discovered on OCS leases in Florida--except the leases near the Florida panhandle--to CPA processing facilities. A pipeline network occurring offshore the Florida panhandle and making landfall in the CPA is assumed for transport of any oil that might be discovered on these leases.

The following discussions provide further information supporting the projected transportation scenario and describe general impacts associated with each method of transportation.

(2) Pipelines

Central Planning Area: As of August 1989, the total length of existing pipelines in the Central Gulf was 26,341 km (Table IV-1). Under the Base Case and High Case scenarios, 201 and 241 km of new offshore gathering lines will be installed (Table IV-1). These new pipelines will be installed to connect new production platforms to existing pipelines or central offshore facilities. Table IV-4 provides the kilometers of pipeline in each analysis area. No new pipeline landfalls are projected under the Base Case and High Case scenarios (Table IV-9). Figure IV-6 depicts the major OCS pipeline landfalls in the Central Gulf.

Western Planning Area: As of August 1989, the total length of existing pipelines in the Western Gulf was 4,322 km (Table IV-2). Under the Base Case and High Case scenarios, 121 and 241 km of new offshore gathering lines will be installed (Table IV-2). These new pipelines will be installed to connect new production platforms to existing pipelines or central platform facilities. Table IV-4 provides the kilometers of pipeline in each analysis area. No new pipeline landfalls are projected under the Base Case and High Case scenarios (Table IV-9). Figure IV-6 depicts the major OCS pipeline landfalls in the Western Gulf.

Eastern Planning Area: No pipelines had been installed in the Eastern Gulf as of August 1989 (Table IV-3). Under the Base Case and High Case scenarios, 80 and 121 km of new offshore gathering lines will be installed (Table IV-3). Some of the new pipelines will be installed in analysis areas E-1 and E-2, located offshore the Florida panhandle (Table IV-4). These pipelines will connect new production facilities to pipeline systems in E-1 not yet built but projected due to previous leasing. The pipelines in E-1 will make landfall in coastal analysis area C-4 in the Mobile, Alabama, and Pascagoula, Mississippi, areas. No pipeline landfalls are projected to occur within the EPA under either the Base Case or High Case scenarios (Table IV-9).

Impacts from the installation of offshore pipelines include effects on water quality, benthic communities, archaeological resources, and fishery resources. Resuspension of bottom sediments occurs as a result of pipeline construction activities. Pipelines are often trenched in order to provide for greater stability and protection from mechanical damage. Approximately 3,200-8,300 m^3 of sediment are displaced per kilometer of pipeline. The effects of sediment resuspension include increased water turbidities and mobilization of pollutants in the water column. Increased turbidity could persist for weeks as a result of pipeline projects. The turbidity could clog the respiratory and filter-feeding mechanisms of numerous benthic and pelagic marine organisms within the affected areas. Turbidity impacts are expected to be short term and reversible.

Bottom sediments on the OCS should not include high concentrations of toxic compounds. The resuspension of these sediments is not expected to result in the release of toxic materials into the water column.

The installation of pipelines across parts of the OCS that include unique and sensitive benthic biological communities, such as coral reefs and hard-bottom, pinnacle, and chemosynthetic communities, could harm the community as a result of mechanical damage from dredging and anchoring activities. Various regulations and stipulations exist to protect sensitive biological resources from damage during a pipeline project. Similarly, prehistoric and historic archaeological resources on the OCS could be damaged from dredging and anchoring activities during a pipeline project. A remote-sensing survey of the pipeline route is required by MMS to identify any possible archaeological resources along the pipeline route.

Commercial fishermen can hang trawls and bottom-set longlines on pipelines and pipeline valves. These hangs result in loss of catch and in damage to fishing gear.

Offshore pipeline failures that can result in oil spills are caused by exposure to numerous hazards, including hydrodynamic forces, soil instability, corrosion, and accidental damage from anchors and trawl gear. Pipeline oil spills are discussed in Section IV.C.

With the increasing trend toward leasing and development in deep-water areas of the Gulf, pipeline installation projects are extending into water depths that will require new technological adaptations. Pipeline projects in nearly 1,000 m of water depth are already planned for the Viosca Knoll area of the Gulf of Mexico and in the Marlim and Albacora fields in offshore Brazilian waters (Timmermanns, 1989). Deep-water pipeline installation challenges include the design of flow line systems that can withstand the high external hydrostatic pressures at the seafloor, the adaption of existing lay-vessel and mooring technology to deep-water conditions, and tie-in problems at deep-water production structures. These technological challenges are being solved, and industry anticipates being able to install pipelines at all expected water depths in the future (McKennhan, personal comm., 1989).

(3) Shuttle Tankers and Barges

Shuttle Tankering

Central Planning Area: Historically, there has been no shuttle tankering of oil to shore in support of the OCS oil industry. However, based on the factors discussed above in "Transportation Assumptions," the following assumptions on the use of shuttle tankers are considered in the impact analyses: For the Base Case, it is expected that 0.3 percent (less than 1%) of oil produced will be transported to shore via shuttle tankering (Tables IV-1 and IV-4). The oil will be loaded at the production site (which could be a tanker-based floating production, storage, and offloading system or a single-point mooring system) and brought directly into four port areas--Port Arthur and Beaumont, Texas; Lake Charles, Louisiana; the Mississippi River Ports system; and Pascagoula, Mississippi--to be offloaded at shore-based terminals located near crude oil refineries.

Section IV.A.3.d. discusses in more detail the locations of ports serving oil tankers. Under the Base Case, three trips of 20,000-dwt shuttle tankers are expected in the CPA from analysis area C-3. Under the High Case, four trips of 20,000-dwt shuttle tankers are expected. The 20,000-dwt tankers, which can carry approximately 133,000 bbl of crude oil, average about 172 m (565 ft) in length by 27 m (89 ft) in breadth and have a draft of about 10 m (34 ft). At this time, no combination of tankering and pipelining is projected.

Western Planning Area: Historically, there has been no shuttle tankering of oil to shore in support of the OCS oil industry. However, based on the factors described above in "Transportation Assumptions," the following assumptions on the use of shuttle tankers are considered in the impact analyses: For the Base Case, it is expected that 18.2 percent of oil produced in the WPA will be transported to shore via shuttle tankering (Tables IV-2 and IV-4). The oil will be loaded at the production site (which could be a tanker-based floating production, storage, and offloading system, or a single-point mooring system) and brought directly into major marine terminal/port areas in Texas where docking offloading space is available near refineries. Section IV.A.3.d. discusses in more detail the locations of ports serving oil tankers. Under the Base Case of Sale 135, 68 trips using 20,000-dwt shuttle tankers are expected in the WPA to transport the crude to shore, primarily from analysis area W-1. Under the High Case of Sale 135, 151 trips of 20,000-dwt shuttle tankers are expected in the WPA. The 20,000-dwt tankers, which can carry approximately 133,000 bbl of crude oil, average around 172 m (565 ft) in length by 27 m (89 ft) in breadth and have a draft of about 10 m (34 ft). At this time, no combination of tankering and pipelining is projected.

Eastern Planning Area: Oil transported from EPA development and production sites by shuttle tankers is projected to travel to assumed offloading terminals at Pascagoula, Mississippi; Mobile, Alabama; and into the Mississippi River corridor ports between Baton Rouge, Louisiana, and the mouth of the River. These terminals would then transport the offloaded oil directly to crude-oil refineries nearby. Because the shuttle tankers will be traveling farther distances to reach shore-based refineries, it is projected that they will be larger than those used in the CPA and WPA. For the Base Case, 99 trips using 50,000-dwt tankers are expected, with 5 trips occurring during the peak year. For the High Case for Sale 137, 223 trips are expected over the 39-year life of the proposed action; 10 trips will occur in the peak year (Tables IV-3 and IV-4). The 50,000-dwt tankers, which can carry approximately 333,000 bbl of oil, average 201 m (660 ft) in length by 32 m (106 ft) in breadth and have a draft of about 12 m (41 ft).

Table IV-5 shows the ports where the oil is expected to be transported and the number of trips to each port for Sales 131/135/137 and total future OCS oil development. The use of deep-water ports is not expected. The CPA deep-water port, LOOP, does not receive tankers of the size projected to be used to transport OCS oil. At present, the smallest tankers LOOP can safely receive at its facilities are about 80,000 dwt (Watson, personal comm., 1989).

Table IV-5

Number of Shuttle Tanker Trips Occurring due to
Sales 131/135/137 and Total Future OCS Oil Development

Major Port Receiving Crude Oil	Number of Trips Base Case (Sales 131/135/137)	All Future OCS Sales
Corpus Christi, Texas	14	201
Freeport, Texas	27	372
Houston/Galveston/ Texas City, Texas	16	229
Port Arthur/Beaumont, Texas	12	153
Lake Charles, Louisiana	0	3
Mississippi River Ports		
(from CPA)	3	45
(from EPA)	73	917
Pascagoula, Mississippi	22	63
Mobile, Alabama	4	57

Impacts from Oil Shuttle-Tanker Operations

The primary environmental concern associated with shuttle-tanker operations is the risk of oil pollution, which can occur as a result of single-tanker operations accidents as well as tanker collisions with other maritime activities. Collisions can result not only in oil spilled from either vessel but also in loss of life and property.

The unfortunate catastrophic oil spill and the detrimental effects that resulted from the *Exxon Valdez* accident in Alaska have increased the public's perception of risks associated with oil-tankering activities. Oil spills of various sizes can occur due to shuttle-tankering activities. Major causes of spills from tankering have included the following (in order of frequency): groundings, 32.6 percent; collisions, 24.4 percent; contacts, 18.6 percent; oil transfer operations, 8.3 percent; fire and explosions, 7.9 percent; weather, 6.2 percent; and mechanical problems, 2 percent (Bao-Kang, 1987). Collision means the striking of two ships. Contact means the striking of an external object by a ship (other than another ship or the sea bottom). Section IV.C. discusses the historical record of spills due to tankering, the likely size estimated to occur, and assumptions and probabilities of such spills from shuttle-tankering operations occurring in association with the OCS leasing program in the Gulf of Mexico.

Although oil-transfer operations account for only 8.3 percent of the large oil spills associated with tanker operations, offloading and onloading of oil during transfer operations result in many more minor spills. Conversations with the U.S. Coast Guard indicate that the major cause of spills less than one barrel in the Louisiana coastal and offshore areas is transfer operations (Westcott, personal comm., 1989). In 1988, the U.S. Coast Guard reported that the current discharge rate for oil during transfer operations is approximately 7.7 spills per 1,000 transfers (Oil Spill Intelligence Report, 1988). Associated with this chronic leakage is air emissions.

While casualty spills, especially groundings or sinkings of tankers, capture the attention of the general public and policymakers and can cause serious detrimental effects, operational discharges occurring from marine-tanker transportation account for the majority of oil discharges. Operational discharges are routine and intentional discharges during normal operating procedures and are allowed by law (although some limitations imposed by regulation may be exceeded during the discharge). Routine tank washing and ballasting operations make up the majority of operational discharges associated with tankering activities. Because some oil remains in the cargo tanks, pumps, and pipelines after transfer of the oil cargo, the cargo tanks of both crude and product tankers must be cleaned with a crude-oil-washing system (COW). When no segregated ballast tanks are provided, ballast water is kept in the cargo tanks and must be subsequentially discharged. The international tanker regulations OILPOL 1954/1969 and MARPOL 1973/1978 stipulate that the instantaneous rates of discharge from cargo tanks must not exceed 60 liters per mile, and the total quantity of oil discharged during any one ballast voyage must not exceed 1/15,000 of the total carrying capacity. MARPOL 1973/1978 sets the same discharge standards, but the maximum quantity of oil permitted to be discharged for new oil tankers is 1/30,000 of the total carrying capacity. If vessels are engaged in long-haul voyages, other regulations require separation of the oil and water content in the tank-cleaning water, thereby retaining the oil on board and allowing the next crude-oil cargo to be loaded on top (LOT) (NRC, 1985; USDC, NOAA, 1981). Crude-oil tankers on voyages of less than 4 days' duration (expected for some shuttle-tankering operations) discharge their ballast and tank-cleaning water directly overboard without separation occurring first. Dr. Lela Jeffrey identified the sources of tarballs collected over a 7-year period in the Gulf of Mexico and found that 25.1 percent of them could be attributed to tanker-cleaning residues (Jeffrey, 1979).

Bilge pumping is the result of oil and water that is generated in the ship's hull from leaking pipes and machinery and from hull-valve connections. The average quantity of bilge oil generated in a tanker in a day is about 19 liters for steam tankers and about 57 liters for motor tankers (NRC, 1985). The quantity of this bilge oil discharged into the ocean depends on whether the tankers are fitted with oily-water separators and on the availability of shore reception facilities. Because tankers use heavy residual bunker fuel for marine applications in diesel engines, the fuel must first be treated to remove impurities. This sludge is discharged about 20 percent of the time for tankers (NRC, 1985). The discharge of such sludge into the oceans is estimated at about 1.4 million bbl per year.

Oil spillage from tanker accidents accounts for only about 7 percent (Gulf of Mexico) to 20 percent (World Oceans) of the total oil pollution occurring due to tankering (USDC, NOAA, 1984a; NRC, 1985). The National Academy of Sciences' (NRC, 1985) report estimates that total transportation oil losses range from 7.4 to 19.2 million bbl per year, with a best estimate of 10.7 million bbl per year. About one-half of this is attributed to operational discharges from tankers (about 5 million bbl annually); the remainder is attributed to bilge water and fuel oil release from all ships (about 2.2 million bbl annually) (often considered an operational discharge), terminal operations (about 150,000 bbl annually), dry-docking (about 222,000 bbl annually), and accidental spillage (about 3 million bbl annually).

Barging

Barging oil rather than transporting it to shore by pipeline has been occurring to a small extent in the OCS waters since the 1950's. Usually, an operator decides at the start of production whether or not to barge the oil. The decision to barge rather than to pipe is contingent on a number of factors. These include the location of the lease block to land, the amount of production expected to occur, the proximity to existing pipelines, and the rates charged by pipeline companies. Barging is often faster and cheaper than the time and expense for laying a new pipeline. Some oil companies simply prefer barging. All of the lease blocks where barging is currently taking place are located fairly close to shore. Barging is expected to remain an activity in waters closest to State waters.

Central Planning Area: At present (as of January 1989), 86 OCS platforms in the CPA barge rather than pipe oil to shore. Tables IV-1 and IV-4 provide statistics on barge traffic projected to occur as a result of the Base Case and High Case scenarios for Sale 131. Historically and for future projections, it is assumed that 3 percent of the oil under the Base Case and High Case scenarios is barged ashore. One hundred ninety-five barge trips and 360 trips are expected to occur due to the Base Case and High Case, respectively; 9 trips are expected during the peak year for the Base Case.

Table IV-6 shows the number of barge trips expected to occur along six major waterways going to eight major terminals receiving CPA barged oil. The majority of the barging activity brings OCS oil to three terminals located in the CPA coastal area: the Haymark Terminal in Lake Charles, Louisiana; the Weeks Island Terminal in Vermilion Bay, Louisiana; and the Chevron Pipeline Empire terminal near the mouth of the Mississippi River.

Western Planning Area: At present (as of January 1989), 10 OCS platforms in the WPA barge rather than pipe oil to shore. Tables IV-2 and IV-4 provide statistics on barge traffic projected to occur as a result of the Base Case and High Case scenarios for Sale 135. Historically and for future projections, it is assumed that 3 percent of the oil under the Base Case and High Case for Sale 135 is barged ashore. Seventy-five barge trips and 165 trips are expected to occur due to the Base Case and High Case, respectively; 3 trips are expected during the peak year for the Base Case.

Table IV-6 shows the number of barge trips expected to occur along major navigational channels going to major terminals receiving WPA barged oil. In the WPA, the Houston Ship Channel, Sabine Pass Ship Channel, and the Calcasieu Ship Channel will receive the barge traffic carrying WPA oil.

Eastern Planning Area: No barging of oil in the Eastern Gulf is expected to occur due to the length of the trip that would be required for barges to bring oil ashore to CPA terminals from EPA platforms.

At present, about 2 percent of the oil produced in the CPA and WPA is barged ashore. This rate has been increasing insignficantly at 0.02 percent annually over the last 5 years. This amount of barging of OCS oil represents barging from the production facility to terminals along the Louisiana and Texas coasts. It does not include the amount of barging of OCS oil that occurs between terminals or from terminals to refineries. Oil piped to shoreline terminals is often then loaded onto barges and transported by barge up rivers and along the Gulf Intracoastal Waterway. In 1989, for example, the Chevron Pipeline Empire Terminal along the Mississippi River received about 6 percent of its domestic oil, or about 4.8 million bbl of oil, by barging operations. If this amount is compared with the projected total amount expected to be barged for all future annual production, 4.9 million bbl, it is evident that the amount of oil barged to the Chevron Pipeline Empire terminal represents not only oil barged from OCS production facilities but also from other terminals.

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Table IV-6

Frequency of OCS Barge Traffic to Coastal Terminals

Coastal Subarea	Terminals Receiving Barged Oil	Waterway Used	Number of Barge Trips (Sale 131) Base Case	High Case	All OCS Sales	Number of Barge Trips (Sale 135) Base Case	High Case	All OCS Sales
C1	Lake Charles	Calcasieu Ship Channel	39	72	1,923	11	25	272
	Gibbstown		20	36	962	4	8	91
C1	Weeks Island	Vermilion Bay/Bayou Teche	39	72	1,923	0	0	0
C2	Gibson	Atchafalaya River	15	27	721	0	0	0
C2	Gibson	Houma/Caillou/Terrebonne	15	27	721	0	0	0
	Cocodrie		20	36	962	0	0	0
C3	Empire	Empire Waterway	44	81	2,163	0	0	0
W2	Texas City	Houston/Tex City/Gal Channel	0	0	0	30	66	726
	Galveston		0	0	0	4	8	91
W2	Port Arthur	Sabine Pass Ship Channel	5	9	240	26	58	635
	TOTAL		197	360	9,615	75	165	1,815

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The most likely capacity of barges used for the transport of OCS-produced oil is 20,000 bbl. Barge-size capacities can range from 5,000 to 80,000 bbl. Once a barge carrying OCS-produced oil reaches coastal waters, it is often linked together with other barges; sometimes as many as three or four barges are pushed by one tugboat. In the Gulf Intracoastal Waterway, as many as eight barges can be transported linked together. The OCS barges collect oil from a number of platforms during their trips offshore, remaining in Gulf waters as much as 1 week from the time they leave their docks.

Impacts from Barging Operations

The types of impacts from barging operations are similar to those from tankers, that is, primarily oil pollution and loss of property and life caused by collisions. Operational discharges resulting in oil pollution are expected to be much less for barges than for tankers because barges in dedicated service do not clean their tanks between loadings, do not require ballasting waters, and do not accumulate large amounts of bilge waters contaminated with fuel oils. However, probably due to the increased number of trips because of lesser capacities, and therefore more onloading/offloading transfer operations, barges have more oil spills than tankers. An examination of Coast Guard statistics on spill incidents occuring in all navigable waters of the U.S. and compiled for years 1984-1986 (U.S. Dept. of Transportation, Coast Guard, 1989b) shows that there are about twice as many barge spills as tanker spills. During 1984-1986, an average of 508 barge spills per year spilled an average of 63,980 bbl per year. In comparison, there were only 206 tanker spills, spilling an average of 95,975 bbl, per year. Although the quantity spilled from tankers appears to be more, the data is skewed by one very large spill that occurred in 1985. If only 2 years of tanker spill data are examined, an average of only 16,197 bbls are spilled per year. The larger percentage of spillage from barges is likely attributed to spills occurring at terminals. See Section IV.A.4.c. for a further discussion of spills at terminals.

(4) Support Vessels and Work Barges

Supplies, services, and personnel must be transported, sometimes long distances, by boats and helicopters to OCS oil and gas structures. Vessel activity servicing the OCS oil and gas industry usually begins at service/supply bases located in the coastal areas. These bases are described in more detail in Section IV.A.4.b. The following provides MMS' projections of service-vessel trips that are expected to occur as a result of the three proposed actions. Assumptions and estimates are that (a) one trip represents a round trip, that is, the vessel travels to and from the service base to the OCS structure, thereby moving through identified navigational channels twice, and (b) service vessels will make three trips per week to exploration and development operations and one trip per week to production platforms.

Central Planning Area: Tables IV-1 and IV-4 provide the number of service vessel trips projected to occur due to the Base Case and High Case scenarios for Sale 131. Under the Base Case, 15,000 service vessel trips are expected to provide supplies and services to the 25 platforms and to the exploratory activity occurring in the CPA during the 39-year life of the proposed action; 1,000 trips will occur during the peak year. Under the High Case, there will be 22,000 trips during the 39-year life of the proposed action, with 2,000 trips in the peak year. The majority of these trips will originate from offshore subanalysis area C-2. Table IV-7 shows the movement of support/service vessels to and from service bases located onshore. The table provides the number of trips to each service base and the expected coastal navigational channels used for these trips. The Calcasieu Ship Channel, the Atchafalaya River, and the Mississippi River and its Passes will receive the bulk of the service vessel traffic.

Western Planning Area: Tables IV-2 and IV-4 provide the number of service vessel trips projected to occur due to the Base Case and High Case scenarios for Sale 135. Under the Base Case, 9,000 service vessel trips are expected to provide supplies and services to the 15 platforms and to the exploratory activity occurring in the WPA during the 39-year life of the proposed action; 1,000 trips will occur during the peak year. Under the High Case, there will be 15,000 trips during the 39-year life of the proposed action, with 1,000 trips in the peak year. The majority of these trips will originate from offshore subanalysis area W-3. Table IV-7 shows the movement of support/service vessels to and from service bases located onshore. The table provides the number of trips to each service base and the expected coastal navigational channels used for these trips. The Matagorda Ship Channel, the Houston-Galveston Ship Channel, and the Sabine Pass Ship Channel in Texas, and the Calcasieu Ship Channel in Louisiana will receive the bulk of the service vessel traffic.

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Table IV-7

Frequency of OCS Service Vessel Usage by Waterway and by Service Base

			Number of Service Vessel Trips (Sale 131)			Number of Service Vessel Trips (Sale 135)			Number of Service Vessel Trips (Sale 137)		
Coastal Subarea	Waterway	Service Base	Base Case	High Case	All OCS Sales	Base Case	High Case	All OCS Sales	Base Case	High Case	All OCS Sales
C1	Calcasieu Ship Channel	Cameron	3,291	4,826	48,043	1,235	2,058	17,562	0	0	0
C1	Freshwater Bayou	Intracoastal City	1,810	2,654	26,424	679	1,132	9,659	0	0	0
		Kaplan	41	60	601	15	26	220	0	0	0
C1	Mermentau Navigation Channel	Grand Chenier	123	181	1,802	46	77	659	0	0	0
C1	Vermilion Bay/Bayou Teche	Louisa	41	60	601	15	26	220	0	0	0
C2	Atchafalaya River	Amelia	96	140	1,397	10	17	142	0	0	0
C2		Bayou Boeuf	48	70	698	5	8	71	0	0	0
C2		Berwick	48	70	698	5	8	71	0	0	0
C2		Freshwater City	96	140	1,397	10	17	142	0	0	0
C2		Morgan City	3,061	4,490	44,694	319	531	4,531	0	0	0
C2	Bayou Lafourche/Belle Pass	Fourchon	526	772	7,682	55	91	779	0	0	0
C2		Leesville	287	421	4,190	30	50	425	0	0	0
C2	Houma/Caillou/Terrebonne	Dulac	670	982	9,777	70	116	991	0	0	0
C2		Houma	478	702	6,983	50	83	708	0	0	0
C2		Theriot	48	70	698	5	8	71	0	0	0
C3	Barataria Waterway/LaLoutre	Grand Isle	281	412	4,097	0	0	0	14	17	74
C3	Miss. River Gulf Outlet	Hopedale	47	69	683	0	0	0	2	2	12
C3	Miss. River and Passes	Venice	2,993	4,390	43,701	0	0	0	150	180	799
C3	Miss. River/Harvey Canal	Harvey	47	69	683	0	0	0	2	2	12
C4	Bayou LaBatre, Ala.	Bayou LaBatre	24	35	351	0	0	0	15	18	79
C4	Mobile, Ala.	Mobile	312	458	4,557	0	0	0	194	235	1,033
C4		Theodore	24	35	351	0	0	0	15	18	79
C4	Pascagoula/Bayou Casotle, Miss.	Pascagoula	48	70	701	0	0	0	30	36	159
W1	Aransas Pass	Port Aransas	0	0	0	80	133	1,133	0	0	0
W1		Ingleside	0	0	0	876	1,460	12,460	0	0	0
W1		Rockport	0	0	0	80	133	1,133	0	0	0
W1	Brazos Santiago Pass	Port Isabel	0	0	0	159	265	2,265	0	0	0
W1	Corpus Christi Ship Channel	Corpus Christi	0	0	0	80	133	1,133	0	0	0
W1	Matagorda Ship Channel	Port O'Connor	0	0	0	1,354	2,257	19,257	0	0	0
W1	Port Mansfield Cut	Port Mansfield	0	0	0	80	133	1,133	0	0	0
W2	Freeport Harbor Channel	Freeport	135	199	1,978	904	1,506	12,851	0	0	0
W2	Houston/Tex. City/Gal. Channel	Surfside	19	28	283	129	215	1,836	0	0	0
W2		Galveston	164	241	2,402	1,097	1,829	15,605	0	0	0
W2		Pelican Island	68	99	989	452	753	6,425	0	0	0
W2	Sabine Pass Ship Channel	Sabine Pass	174	255	2,543	1,162	1,936	16,522	0	0	0
E1	Panama City Harbor Ship Channel	Panama City	0	0	0	0	0	0	1,728	2,152	7,953
E3	Fort Myers Beach Inlet	Fort Myers	0	0	0	0	0	0	520	792	3,614
E3	Tampa Bay Ship Channels	Port Manatee	0	0	0	0	0	0	2,330	3,548	16,168
	TOTALS		9,000	15,000	128,000	15,000	22,000	219,000	5,000	7,000	30,000

Eastern Planning Area: Tables IV-3 and IV-4 provide the number of service vessel trips projected to occur due to the Base Case and High Case scenarios for Sale 137. Under the Base Case, 5,000 service vessel trips are expected to provide supplies and services to the 10 platforms and to the exploratory activity occurring in the EPA during the 39-year life of the proposed action, with 1,000 trips during the peak year. The majority of the trips will originate from offshore subplanning area E-3. Table IV-7 shows the movement of support/service vessels to and from service bases located onshore. The table provides the number of trips to each service base and the expected coastal navigational channels used for these trips. Port Manatee in Tampa Bay and the Panama City service bases will receive the bulk of the service vessel traffic.

The types of vessels working for the oil and gas industry are extremely varied but can be divided according to their function into three basic types--supply, crew, and utility vessels. These offshore vessels also can be grouped into two sizes--small (60-149 ft, usually 100-120 ft) or large (150 ft or more, usually 160-200 ft). Most of the vessels used are supply boats that are in the large category (68%) (Reed, 1987). These supply boats are about 180 ft long, have a 12-ft draft when loaded, and can carry 30 tons of materials. Crewboats range from 50 to 100 ft in length, with 7- to 9-ft drafts. Dry-cargo supply and crewboats make up about 89 percent of all vessel types (Reed, 1987). Utility boats perform various functions for rigs and are about 100 ft long with 10- to 12-ft drafts. The following lists the types of boats needed for OCS oil and gas exploration, development, and production:

anchor-handling supply ships
container carriers
coring vessels
crewboats
crew/supply boats
dedicated spill response vessels
derrick vessels
firefighting vessels
geochemical survey/analysis boats
lift boats (self-propelled/self-elevating)
line-handling boats
maintenance support boats
multiservice vessels
pipe carriers
production vessels
platform supply boats
research vessels
standby boats
supply boats
survey boats
tugs/supply boats
utility boats
well service boats

Sources: Reed (1987) and MMS in-house information (1989).

Commodities transferred between offshore and onshore are as varied as the types of vessels and include such items as drilling fluids, mud, cement, diesel fuel, drilling equipment, pipes, food, and water. Assuming an average of 338 tons per trip (Reed, 1987), five million tons of cargo will be transported on the OCS to rigs and platforms during the lease life of the Sale 135 Base Case.

Impacts from Service Vessels

The type and size of vessel and the vessel speed and route must be considered when evaluating potential impacts. Service vessel use on the OCS can cause four types of impacts: (a) space-use conflicts between the maritime-commerce and fishery use of the water space and the vessel routes; (b) damage to and loss of commercial and recreational fishing gear; (c) biological damage due to oil pollution and alteration of the natural habitat by vessel movement and anchoring operations; and (d) collisions with marine mammals or endangered species. Collisions resulting in property damage, fire, and loss of life also can occur from the larger service vessels. Fishery-resource impacts include fish dispersal and reduced fish catchability, as well as direct effects on eggs and larvae (Wingert, 1988). Deck drainage, bilge pumping, and trash can affect water quality and associated biota. Navigation channels built to support service-vessel traffic change current and circulation patterns and allow saltwater intrusion into wetland areas. Frequent vessel traffic leads to accelerated erosion along navigation channels in the coastal area and to increased turbidity and other secondary impacts. Impacts due to navigation channels are discussed in Section IV.A.4.e.

(5) Anchoring Activities

If anchors and anchor chains from support boats and ships, floating drilling units, and pipeline-laying vessels are dropped directly on top of corals and other live-bottom areas, they can do a great deal of damage. The area actually affected will depend on water depth, chain length, the size of the anchor and chain, wind, and current. Anchor damage includes crushing and breaking of coral heads. Also, anchoring often destroys a wide swath of sessile organisms when the anchor is dragged or the vessel swings at the anchor causing the anchor chain to drag the seafloor.

Continental Shelf Associates (CSA) documented the damage caused by a single anchoring incident at the East Flower Garden Bank. The vessel involved was a tug with an attached barge. The predominant area of impact was approximately 3 m wide and 61 m long. Beyond this band, CSA observed intermittent impact in a band extending an additional 122 m. Initially, CSA attempted to count the individual coral colonies impacted; however, they abandoned the count after 200 colonies within 61 m. Mechanical damage to the coral colonies occurred with varying degrees of severity. Slight abrasions of the tissue were widespread. A more severe impact was the complete removal of coral tissue. Finally, the most severe damage resulted from the anchor cable that sawed coral heads in half, severed heads from their attachment points, and created deep gouges and fractures. Relatively minor impacts can lead to more severe effects due to the introduction of disease or algal infections into the damaged coral tissues. These infestations can lead to mortality of the entire colony (CSA, 1984).

Anchoring is considered to be the most serious single cause of damage to offshore benthic communities from oil and gas activities. If the Live-bottom and Topographic-features Stipulations proposed in Sections II.A.1.c., II.B.1.c., and II.C.1.c. were adopted, anchoring by the offshore industry could be prevented. Even if the stipulations are adopted, however, MMS cannot regulate the anchoring of vessels not associated with the offshore oil and gas industry, such as dive boats, fishing boats, and large freighters and tankers, all of which have been observed anchoring at the Flower Garden Banks. Establishment of a Flower Gardens Banks National Marine Sanctuary (Section I.B.4.n.) will enable anchoring to be prohibited at those very important features, but anchoring on other important benthic habitats will remain unregulated.

e. Offshore Emissions and Discharges, Descriptions, and Estimates

(1) Drilling Muds and Cuttings

The discharges made in drilling OCS oil and gas wells have been the subject of a great deal of research and public debate with regard to their potential effects on the marine environment. Considerable research has been conducted on this subject, by industry as well as academia, and the NRC (1983) has reviewed the literature and produced an authoritative report.

Drilling fluids are required in rotary drilling for oil and gas exploration and development to remove cuttings from beneath the bit, to control well pressure, to cool and lubricate the drill string, and to seal the well. For a detailed description of the use of muds, see Offshore Operators Committee (1976). There are no viable alternatives to using manufactured muds as a circulating fluid during the majority of Gulf of Mexico drilling. Although drilling fluids are recirculated during drilling and sometimes can be held and reused in drilling multiple production wells, they must be eventually disposed of because of their contamination with suspended material, their loss of important properties, or the weight and space limitations on drilling vessels. Cuttings from the drilled formation are removed from the drilling fluid and must also be disposed of. Although drilling discharges can be barged ashore or to other sites at sea for disposal, cost and operational considerations favor onsite disposal by either overboard discharge or shunting through a pipe to some depth. Land disposal is now required for certain drilling fluids (e.g., oil-based drilling fluids).

Drilling fluids used on the OCS are composed of bulk constituents and special-purpose additives. The principal bulk constituents are water, barite (barium sulfate), clay minerals, chrome lignosulfonate, lignite, and sodium hydroxide. All of these constituents are nontoxic to marine organisms at the dilutions reached shortly after discharge. Based on observations of discharges, the plumes are spread out at some depth appropriate to density characteristics and are rapidly dispersed by the turbulent diffusion characteristics of the ocean. Horizontal turbulent diffusion results in dilution of the plumes by a factor of 10,000 or more within an hour of release and an even greater dilution of suspended components because of settling (Brandsma and Sauer, 1983). Several common drilling-fluid additives, including biocides and diesel fuel (No. 2 fuel oil), are much more toxic to marine organisms than the bulk constituents.

Oil-based muds may not be discharged nor may water-based muds in which diesel is an additive. Where oil other than diesel is added to the mud system, it may be discharged so long as there is no visible sheen on the receiving waters and the mud meets the toxicity limitation imposed by USEPA in the NPDES General Permit.

More than 96 percent of the whole drilling fluids tested in short-term experiments (from 44 to 144 hours) have LC_{50} values greater than 1,000 ppm (which are achieved in offshore oil and gas drilling activities only within a few meters of the discharge point) and are classified as "slightly toxic" or practically "nontoxic" by the IMCO et al. (1969) characterization of toxicity. More than 98 percent of the tests that have used the suspended-particulate phase of drilling fluids found their LC_{50} values greater than 10,000 ppm (in the range of "practically nontoxic"). This distribution of toxicities, representing over 70 drilling fluids and more than 60 species of marine organisms, indicates that most water-based drilling fluids are relatively nontoxic (NRC, 1983).

The National Academy of Sciences (NRC, 1983) made a comprehensive study of the literature on the fate and effects of drilling fluids in the marine environment. In brief, this report concluded the following:

> This review of existing information on the fates and effects of drilling fluids and cuttings on the OCS shows that the effects of individual discharges are quite limited in extent and are confined mainly to the benthic environment. These results suggest that the environmental risk of exploratory drilling discharges to most OCS communities are small. Discharges from oil and gas field development drilling introduce greater quantities of material into the marine environment over longer periods of time. Results of field studies suggest that the accumulation of materials from these longer-term inputs is less than additive and therefore the effects of exploratory drilling provide a reasonable model for projecting the effects of development drilling. Uncertainties regarding effects still exist for low energy depositional environments which experience large inputs of drilling discharges over long periods of time.

Based on the NRC findings, MMS has concluded that drilling fluids used on the OCS are unlikely to cause any significant ecological damage beyond 1,000 m from the discharge point either in the short term or the long term. At most depths typical of the continental shelf, the majority of discharged fluids and cuttings are initially deposited on the seabed within 1,000 m of the discharge point. This material may persist as initially deposited or may undergo rapid or prolonged dispersion, depending on the energy of the bottom-boundary layer. Effects on benthos have been observed in the field under low to moderate energy regimes within 1,000 m of the discharge point.

This view was reiterated at a "Mobile Bay Area Drilling Fluids Transport Workshop" held on December 6-8, 1983. The Biological Resources subgroup concluded that:

> Toxicity does not seem to be a problem at the concentrations of material found at distances greater than 200-500 m from the discharge point, and certainly not at distances greater than 1,000 m. Most of the toxicity seems to be due to the presence of 3-6 percent diesel oil in the discharges. Eliminating the use of diesel may reduce toxicity to insignificant levels.

In addition to toxic effects, the discharges, particularly the cuttings, form a low mound on the bottom beneath the discharge. Approximately 511 yd^3 of cuttings are produced during the drilling of an exploration well, depending on the depth of the well. Nonmotile plants and animals covered by this mound may be smothered; and, to the extent that this mound exhibits different substrate characteristics (such as grain size, organic content, etc.) from the original bottom, the plants and animals that colonize the mound will be different. However, observations on such mounds show that they are colonized and reworked and that after some period of time become indistinguishable from the surrounding bottom (Zingula, 1975). Furthermore, Menzie (1983) points out that it is the physical change of the substrate rather than any toxic effects that causes a change of benthic fauna around drilling rigs.

All the above notwithstanding, the direct discharge of muds and cuttings on small and productive areas such as coral reefs and live bottoms would devastate delicate ecological relationships, and the resulting change in sediment characteristics could prevent recovery of the predrilling condition. It is for this reason that a lease stipulation has been included in appropriate leases since 1973, and such a stipulation is proposed (the Topographic-features Stipulation in Sections II.A.1.c.(1) and II.B.1.c.(1)) as an option for proposed Sales 131/135/137.

(2) Produced Waters

During production of oil and gas, fossil or connate water located in the permeable sedimentary rock strata may be brought up to the surface. This water is called produced water, formation water, or oil field brine. The amount of produced water generated per volume of oil varies greatly. In older wells, as oil and gas production declines, most wells produce increasing amounts of water. In some oil fields, water emerges with the oil in the early stages of development; whereas in other wells, appreciable water never comes up with the oil. The amount of produced water generated from future oil and gas operations is projected based on data gathered by the American Petroleum Institute for the Gulf of Mexico and is examined in a 1987 USEPA report to Congress on oil field waste (USEPA, 1987; Ehrhart, personal comm., 1989). On an average, 8.42 bbl of produced waters are discharged for every bbl of oil produced, and 17.7 bbl of produced water are generated per MMcf of gas. Applying these averages to expected oil production for the three sales provides estimates of 1,116, 433, and 338 MMbbl of produced water generated during the lives of Sales 131, 135, and 137, respectively.

Produced waters are salt solutions containing higher levels of dissolved solids (salinity) than seawater. Water produced from different strata and different petroleum reserves may differ significantly in chemical composition (Knecht, 1988). Salinity of produced water usually ranges between 75 and 225 grams/kilogram (g/kg) compared to seawater at 35 g/kg (Boesch, 1988). In addition, produced waters may contain elevated concentrations of several metals and elemental sulphur and sulfide. Metals that may be present in produced waters in higher concentrations than seawater include aluminum, barium, beryllium, cadmium, chromium, copper, iron, lead, manganese, nickel, silver, vanadium, and zinc. Produced waters generally have little or no dissolved oxygen. The water may contain high concentrations of total organic carbon and dissolved organic carbon, primarily in the form of volatile aromatic hydrocarbons and aliphatic hydrocarbons (Knecht, 1988). Other soluble organic compounds, with concentrations generally greater than several hundred parts per million, are poorly characterized but include phenols and organic acids (Boesch and Rabalais, 1989a). Environmentally high concentrations of naturally occurring radionuclides, primarily in the form of radium (Ra-226 and Ra-228), are found to exist in Gulf Coast oil field production waters.

Produced water may be (a) reinjected into the formation or (b) treated to decrease its oil content and then discharged into surface waters. Although much of the water produced from OCS oil and gas operations is discharged directly at offshore production platforms into surrounding waters, some are piped ashore and then discharged into nearshore or estuarine waters. (Section IV.A.4.k.(1) discusses onshore disposal of produced waters.)

There have been a number of studies investigating the effects of produced waters on marine ecosystems. Dilution of produced water in offshore waters is very rapid. In the Buccaneer Oil Field study (Middleditch, 1981), total hydrocarbon concentrations in the water column rarely exceeded 30 ug/l in the vicinity of the produced water discharge, even though total petroleum hydrocarbon concentrations in the produced waters were 20 mg/liter and the major source of hydrocarbons in the area was associated with the discharge of produced brines. Harper (1986) concluded that diffusion and dispersion limit biological effects of produced waters to within a few meters of the discharge point in offshore waters.

In two reports, Brooks (1979) and Brooks et al. (1977), Dr. J. Brooks concludes that produced waters are an important source of light petroleum hydrocarbons to the Texas-Louisiana shelf waters, particularly large amounts of low-boiling aromatics such as benzene and toluene. Information and study results regarding volumes and impacts of produced waters discharged into coastal waters can be found in Section IV.A.4.k.(1).

(3) Treated Sanitary and Domestic Wastes

Wastewater resulting from offshore activities include deck drainage, solid wastes (i.e., sanitary and domestic wastes), cooling water, and desalinization-unit discharges. Deck drainage is all waste resulting from platform washings, deck washings, tank cleaning operations, and runoffs from curbs and gutters, including drip pans and work areas. Sanitary wastes are treated wastes from toilets, and domestic wastes are materials discharged from sinks, showers, laundries, and galleys. Cooling water is defined by USEPA as "noncontact" water used for cooling machinery, and desalinization discharges are those wastes resulting from the creation of freshwater from seawater. These discharges are regulated by USEPA through NPDES. The current Gulf of Mexico General Permit was published in the *Federal Register* on July 9, 1986 (51 FR 24897).

The volume and concentration of sanitary wastes will vary widely with time, occupancy, platform characteristics, and operation situation. In offshore operations, toilets are usually flushed with brackish water or seawater. Concentrations of fecal coliform bacteria serve as an indicator of the potential pathogenicity of water resulting from the disposal of human wastes. Specific levels of suspended solids and chlorine residual in an effluent are indicative of corresponding levels of fecal coliform. If the suspended-solid levels in an effluent are less than 150 mg/l and the chlorine residual is maintained at 1.0 mg/l, then fecal coliform levels should be less than 200 per 100 ml. Properly operating biological treatment systems on offshore platforms have effluents containing less than 150 mg/l of suspended solids; therefore, chlorine residual is a reasonable control parameter. Any impacts on the water quality of receiving waters of discharges meeting USEPA requirements will be minimal and confined to an area within a few meters of the discharge site; such discharges are rapidly diluted and dispersed.

(4) Air Emissions

The major impact-producing factors on air quality from OCS-related activity are due to combustion, evaporation, or venting of hydrocarbons. Commonly used equipment that generates air emissions are diesel-powered generators and pumps. In the offshore environment, potential impact-producing activity includes catastrophic events (blowouts with fire or the release of sour gas) and operational emissions.

Air pollutants associated with OCS activities include nitrogen oxides (NO_x), carbon monoxides (CO), sulphur oxides (SO_x), total suspended particulates (PM_{10}), and volatile organic compounds (VOC)/hydrocarbon compounds. Ozone (O_3) is not emitted directly by any source; ozone is formed in a photochemical reaction in the atmosphere involving VOC and NO_x. NO_x consists of nitric oxide (NO) and nitrogen dioxide (NO_2). NO_x is formed through the combination of oxygen and nitrogen in the air during the combustion process. The rate of formation increases as combustion temperature increases. Most emissions are initially in the form of NO, which will slowly oxidize in the atmosphere to form NO_2. CO is formed by incomplete combustion. Operational emissions occurring offshore as the result of OCS activities produce a negligible quantity of CO. SO_x is formed in the combustion of fuels containing sulphur. SO_x in the atmosphere slowly converts to sulfate particles, which in the presence of atmospheric vapor (clouds) may produce sulfuric acid mist. Entrainment of sulfate particles into storm clouds may contribute to reduced pH levels in precipitation. If the pH reduction is significant, acid rain will result. The PM_{10} emissions associated with combustion consist of small particles less than 10 microns in diameter. Particulates of this size range can cause respiratory illness and tend to reduce visibility in the atmosphere if in sufficient concentration. O_3 may be formed when NO_2 breaks down under the influence of sunlight, producing NO and atomic oxygen (O), which then combines with diatomic oxygen (O_2) to O_3. The atomic oxygen (O) may combine with any of various hydrocarbon compounds (VOC) to form gaseous and particulate compounds that, if in sufficient concentration, may result in physiological irritation and reduced visibility.

Operational emissions from offshore activity activities typically emit constant levels of VOC, NO_x, CO, SO_x, and PM_{10}. The levels and effects of these emissions on ambient air quality constitute the impact-producing factor of operational emissions. Specifically, if normal operational emissions from these sources degrade the air quality of onshore areas such that the NAAQS are exceeded, a threat may exist to the health of individuals and to the welfare of the natural environment of the affected area. Many conditions define the magnitude of this threat, such as the number of pollutants present, the concentration (density) of the pollutant(s), and meteorological conditions by area over time.

Operational emissions in the offshore environment are generally low level, constant, long termed, and regional in extent. Catastrophic events generally produce high-level emissions over a very short term in a localized area.

Catastrophic events such as blowouts, with or without fire, are nonroutine in nature and are unpredictable. A blowout that results in a discharge of gas would have the potential to negatively affect air quality in the vicinity of the discharge. Resultant degradation of air quality would be temporary, as such emissions are rapidly diluted and dissipated by the winds in the offshore area. If the blowout occurs with fire, quantities of combustion products would be released; without fire, amounts of natural gas and possible hydrogen sulfide (H_2S) would be released. Under conservative conditions of a nearshore blowout, accompanied by a stable atmosphere and light winds toward shore, the release of combustion products from a blowout and fire could impact onshore air quality.

(5) Noise Emissions

Noise emissions resulting from OCS development are associated with the construction and operation of offshore structures, drilling rigs, seismic-geophysical surveying, petroleum-transfer facilities, onshore processing plants, pump stations, aircraft, and vessels.

No onshore noise impact is expected from normal operations of OCS structures--even under low background-noise conditions, these operations would not be audible from shore. Onshore noise levels could be slightly increased by vessel, vehicle, and helicopter traffic; however, these increases are generally expected to be small. Most of the onshore processing and support facilities would necessarily be located in industrially zoned areas where noise would have a minimal impact. If adverse noise impacts could result, mitigation measures such as sound barriers (i.e., earthen berms, block walls, etc.) and mufflers could be used. The site-specific noise impacts of these developments will be considered in future environmental documents when detailed development plans are known.

Noises from drilling and production structures generally are similar to those from shore-based operations. Compressors and diesel engines usually are the loudest equipment on a typical structure, emitting about 90 decibels (db) at a distance of 15 m (50 ft). By comparison, a diesel truck under full load also emits about 90 db at 15 m. Although other sounds such as the banging of pipes may be more intense, they are of short duration. The effect of harmful levels of noise emissions to structure personnel can be mitigated by standard safety practices and noise-attenuation devices.

Acoustic stimuli may also modify animal behavior and physiology, depending on the species studied, characteristics of the stimuli (i.e., amplitude, frequency, pulsed, or nonpulsed), season, ambient noise, previous exposure of the animal, physiological or reproductive state of the animal, and other factors. Possible adverse effects from loud sounds include auditory discomfort due to loudness/pressure changes, possible hearing loss, the potential masking of sounds such as might be used in intraspecies communications, and behavioral responses resulting in avoidance of an area. Human activities associated with OCS exploration and development, especially air and vessel traffic near nesting waterfowl and seabirds, could reduce productivity of some species and may cause abandonment of important nesting, feeding, and staging areas. The responses of birds to human disturbances are highly variable. These responses depend on the species; the physiological or reproductive state of the birds; distance from the disturbance; type, intensity, and duration of the disturbance; and many other factors. Waterfowl nesting on deltas and islands may also be disturbed by aircraft and vessel traffic, and some disturbance of molting and staging birds is likely to occur. However, effects studied by Ward and Sharp (1974) and Gollop et al. (1974) indicate that long-term displacement or abandonment of important molting and feeding areas due to occasional aircraft disturbance is unlikely.

Subsea noise could have an adverse effect on fish, sea turtles, marine mammals, and Naval activities. Gales (1982) points out that in light seas the surface noise propagated by aircraft and vessel traffic, as well as human presence associated with OCS-related oil/gas activities, could adversely affect subsea marine mammals that occupy overwintering and breeding areas in or near sale areas. Short-term responses of whales to acoustical disturbances that have been demonstrated include flight and startle response; vacating an area; deflecting migration routes; and changes in swimming, diving, and respiratory characteristics. The degree of responses ranged from those so subtle that statistical analysis was necessary (Malme et al., 1984) to determine whether or not a change had occurred to total abandonment of an area for several years and return only when historic ambient noise levels were restored. There are many areas where industrial noise had been ongoing for several years; whales have continued to utilize these areas, to some degree, during their migration cycle. If acoustical disturbances persist in critical areas, long-term effects may result. Such long-term effects may include permanent abandonment of some habitats, physical damage, auditory-system damage, and changes in some portion or timing of the whales' migratory cycle. Areas where long-term effects may be most likely to develop are in habitats where ambient noise levels do not presently include high levels of industrial noises (e.g., summer-feeding areas and overwintering areas) or where many whales use a small area intensively. Habituation may be possible if increases in industrial noise levels proceed at a very slow rate (20-40 years).

(6) Additional Loss of Trash and Debris

Public and private interests have indicated that debris associated with industrial ocean users including oil and gas operators (oil drums, large plastic containers and sheeting, computer read-write rings, seismic markers, styrofoam floats, pipe-thread protectors, diesel filters, and hard hats) is a serious, chronic problem on major recreational beaches in the Western and Central Gulf (Reggio, 1989b). Removal, analysis, and disposal of beached 55-gallon drums along South Texas beaches cost the Federal Government upwards of $400,000 in 1985. Over one-half of the 300 drums whose contents were analyzed in 1985 were found to contain hazardous materials, thereby posing potential health hazards to beach users, marine resources, and wildlife. Additional impacts caused by marine debris in the Gulf of Mexico are the entanglement of birds, fish, sea turtles, and marine mammals in plastic rope, straps, or netting and the ingestion of plastic bags, sheeting, 6-pack rings, and styrofoam particles (Centaur Associates, Inc., and Center for Environmental Education, 1986). Others in the Central and Western Gulf have also noted the recurring problem of debris wash-up from industrial ocean users affecting beach use, aesthetics, and beach-maintenance requirements along the Gulf of Mexico shorefront. A special MMS scoping report on beach litter and presentations at several Gulf of Mexico Information Transfer Meetings (USDI, MMS, 1985b, 1986b, 1987c) demonstrated the significance of the beach litter problem Gulfwide and implicated the oil and gas industry as a major contributor in the CPA and WPA. In addition, buoyant debris within the marine environment can affect vessel operations in the Gulf of Mexico.

Marine-debris education and training and several legal and operational changes affecting oil and gas operations in the past few years are reducing accidental loss of solid waste from most offshore operations. Broad support and major participation by many oil and gas companies in beach cleanup and beach-adoption programs in the CPA and WPA reflect their concern and resolve to be part of the solution instead of the problem.

4. Onshore Infrastructure

a. Pipelines

Central Planning Area: There are currently 4,448 km (2,764 m) of onshore pipelines associated with OCS oil and gas production in the Central Gulf (Table IV-8). Nearly all of these pipelines have been installed in coastal Louisiana (coastal subareas C1, C2, and C3). Only 179 km (111 mi) of pipelines occur in coastal Mississippi. Of the 150 pipeline landfalls that have occurred in the Central Gulf, all but 6 have been in coastal Louisiana. No new pipeline landfalls or onshore pipeline projects are anticipated as a result of the Base Case and High Case scenarios (Table IV-9).

Western Planning Area: Data are not available on the extent of the onshore pipeline network associated with OCS oil and gas production in the Western Gulf. Nineteen pipeline landfalls from the OCS have occurred in the State of Texas (Table IV-8). No new pipeline landfalls or onshore pipeline projects are anticipated as a result of the Base Case and High Case Scenarios.

Eastern Planning Area: There are currently no onshore pipelines or pipeline landfalls associated with OCS oil and gas activities in the Eastern Gulf. No new pipeline landfalls or onshore pipeline projects are anticipated as a result of the Base Case and High Case scenarios.

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Table IV-8

Summary of Existing OCS-related Onshore Facilities by Coastal Subarea*

Coastal Subarea	Gas Processing Plants	Navigation Channels	Oil Refineries	Onshore Pipeline (km)	Pipe Yards	Pipeline Landfalls	Platform Yards	Separation Facilities	Service Bases	Terminals
C1	18	4	5	1,453	4	49	3	23	5	32
C2	16	4	3	1,571	3	53	9	12	11	23
C3	9	10	7	1,246	3	42	4	18	4	25
C4	3	3	3	179	0	6	3	0	4	0
Central Gulf Subtotal	46	21	18	4,448	10	150	19	53	24	80
W1	19	6	6	NA	0	5	5	5	7	5
W2	17	3	14	NA	3	14	6	8	4	9
Western Gulf Subtotal	36	9	20	NA	3	19	11	13	11	14
E1	1	2	0	0	0	0	0	0	1	0
E2	0	1	0	0	0	0	0	0	0	0
E3	0	3	0	0	0	0	0	0	2	0
E4	0	0	0	0	0	0	0	0	0	0
Eastern Gulf Subtotal	1	6	0	0	0	0	0	0	3	0
Gulf Total	83	36	38	4,448	13	169	30	66	38	94

NA - Denotes that the data/estimate is not available.

*Shown on Figure IV-1.

Source: USDI, Minerals Management Service, Gulf of Mexico OCS Region, 1989.

Table IV-9

Summary of Projected OCS-related Onshore Facilities by Planning Area

Number of New Facilities by Type

	Central Gulf		Western Gulf		Eastern Gulf		
	Sale 131	Total OCS	Sale 135	Total OCS	Sale 137	Total OCS	Location of New Facilities by Coastal Subarea
Gas Processing Plants	0	0	0	0	0	0	Not applicable
Navigation Channels (km)	0	0	0	0	0	0	Not applicable
Oil Refineries	0	0	0	0	0	0	Not applicable
Onshore Pipeline (km)	0	48	0	121	0	0	48 in C-4; 81 in W-1; 40 in W-2
Pipe Yards	0	1	0	1	0	0	1 in C-4; 1 in W-1
Pipeline Landfalls	0	3	0	3	0	0	3 in C-4; 2 in W-1; 1 in W-2
Platform Yards	0	0	0	0	0	0	Not applicable
Separation Facilities	0	2	0	0	0	0	2 in C-4
Service Bases	0	0	0	0	0	0	Not applicable
Terminals	0	3	0	3	0	0	3 in C-4; 2 in W-1; 1 in W-2

Source: USDI, Minerals Management Service, Gulf of Mexico OCS Region, 1989.

Pipeline landfalls are considered a major impact-producing factor for several reasons. One of these is that installing and burying the pipeline in shallow nearshore waters can temporarily disturb bottom communities and increase coastal turbidity levels. A second is that the dredging of channels across coastal landforms such as barrier beaches and wetlands could alter coastal processes or create zones of weakness that could result in accelerated erosion or landscape changes in the vicinity of the landfall. However, a recently completed MMS-funded study (Wicker et al., 1989) indicates that along the Texas, Louisiana, and Mississippi coasts, pipeline landfalls have not had a noticeable impact on normal shore processes. Other studies of individual pipeline projects show that pipeline landfalls can be made with minimal environmental impacts (LeBlanc, 1985; Mendelssohn and Hester, 1988). Onshore, the dredging of pipeline canals results in the direct conversion of wetland habitat to open-water and spoil-bank habitats. The canals also can alter wetlands hydrology, resulting in wetlands impacts associated with saltwater intrusion and drainage alterations.

The need to replace existing pipeline landfalls as a result of the aging and deterioration of the offshore pipeline network could result in additional onshore impacts. Figure IV-2 shows that a large percentage of OCS pipeline landfalls are 20 or more years old. External corrosion would be a major cause of the deterioration of these lines. Since 1970, pipelines have been installed with a cathodic protection system with sacrificial anodes to protect the line from corrosion. Pipelines installed before 1970 are protected by running an electric current through the pipeline from the platform that feeds the line. Cathodic protection greatly extends the life expectancy of a marine pipeline; and, at the present time, industry does not anticipate that a program to replace aging pipelines will be needed. In the event that a pipeline-landfall section does need to be replaced, it is likely that the original landfall right-of-way will be used.

In the past, the open-ditch and push-pull methods have been used to install pipelines in coastal areas. In the open-ditch method, a canal 12-15 m wide and 2-3 m deep, often with an additional trench in the bed of the canal to provide 3.5-4 m of clearance above the pipeline, was first excavated to allow for the passage of a pipeline lay barge through the canal. These open-ditch canals were not backfilled after the laying operation. The open-ditch method has been very destructive to marshes because of the large size of the canals and the associated prominent spoil banks. With the push-pull method, a much narrower trench is excavated, usually with a trenching machine that is operated from a marsh buggy. The pipeline is welded and pushed up the canal from a barge anchored in a navigable water body at the downstream end of the canal. Flotation devices are often attached to the pipe as it is pushed up the canal. After the pipeline is lowered into the canal, the canal is usually backfilled with the dredge material that had been piled along the sides of the canal.

A recently completed MMS study (Turner and Cahoon, 1987) of the impacts of OCS-related activities on coastal wetlands has determined that the direct impacts of pipeline installations have averaged 2.49 ha/km of impact in Louisiana. The mean impact for backfilled canals is 0.91 ha/km compared to 3.70 ha/km for nonbackfilled canals. The direct impacts of these pipeline projects include the conversion of wetlands to open-water or upland-spoil banks, and the subsequent widening of the canal as a result of bank erosion. Also, operation of heavy equipment in coastal marshes and swamps adjacent to canals can be very destructive to these habitat types for many years.

Pipeline installations also produce indirect impacts. The spoil banks that line open-ditch pipeline canals can interfere with natural drainage from the marshes and increase the amount of waterlogging that occurs in marsh soils. Drainage is particularly impaired where two or more canals intersect and impound or semi-impound wetland areas. Poor drainage impairs the growth of wetland vegetation and encourages the conversion of wetland areas to open water. Another potential indirect impact of pipeline canals is to encourage saltwater intrusion. Linear canals that connect different salinity environments can encourage the movement of saline water into fresher areas. If canals are backfilled, however, the penetration of saltwater is prevented or inhibited. On the other hand, if a canal is left open and spoil banks remain beside it, the spoil banks will inhibit or prevent the movement of saltwater from the canal onto the marsh surface. Turner and Cahoon (1987) indicate that there is little correlation between salinities in a canal and those in adjacent marsh areas. Apparently, high-salinity water from a canal is introduced into a marsh periodically as a result of overbank flooding during high-water stages and not continuously through subsurface seepage. Under some circumstances, dredged spoil banks may actually operate to inhibit the movement of saltwater from the canal onto the marsh. The spoil banks, however, may also operate to retain high-salinity water within the marsh after inundation has occurred. Based on current available information, therefore, it is not possible to make an unequivocal statement about the relationship between pipeline canals and saltwater intrusion onto wetlands.

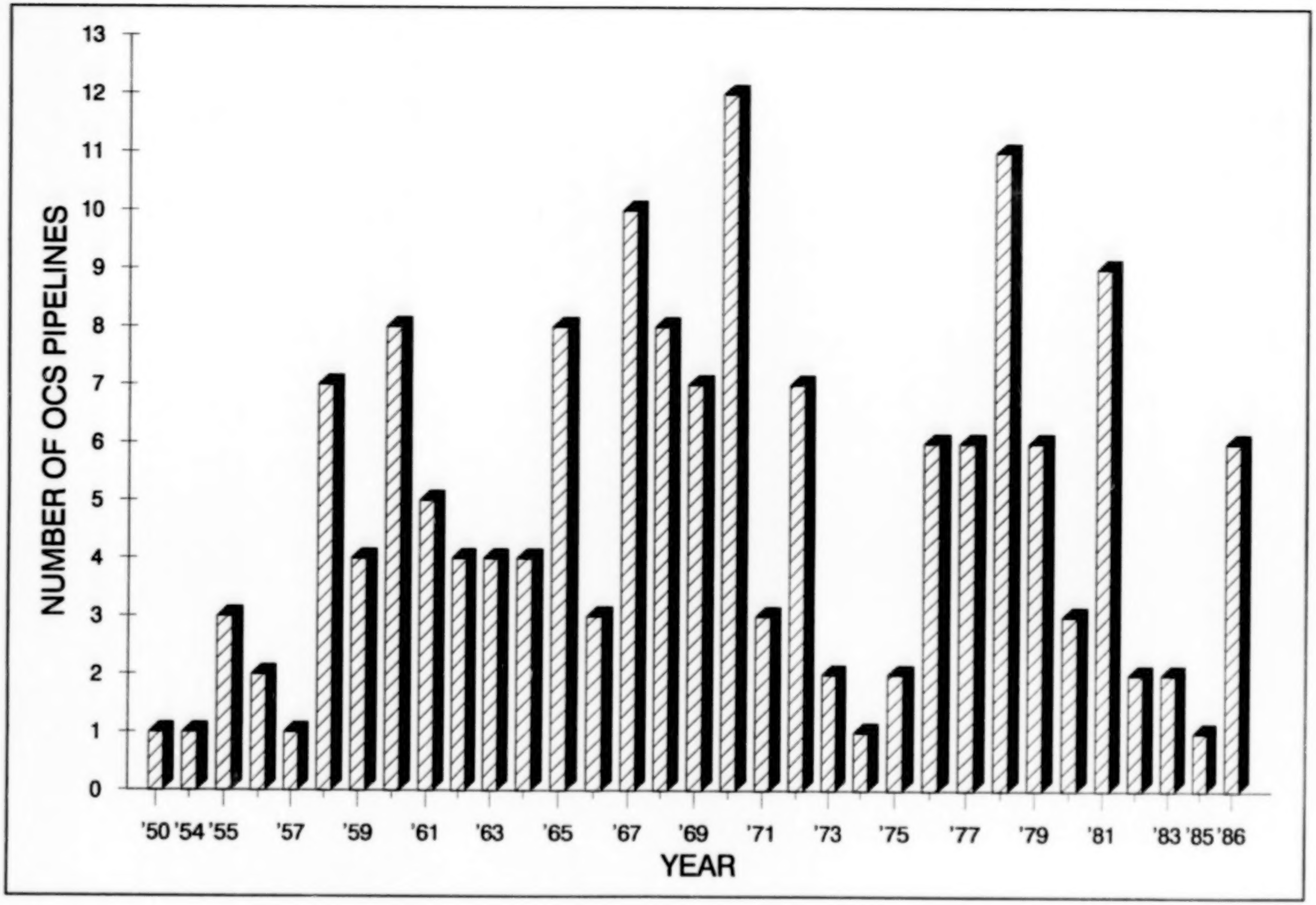

Figure IV-2. Number of OCS Pipeline Landfalls.

In general, in coastal wetlands, both direct and indirect impacts of pipeline canals are reduced when the canal is backfilled immediately after the pipeline is installed. In a marsh habitat, if a pipeline is covered with spoil from the trench, revegetation by marsh species will occur and impacts will be minimized. The absence of spoil banks restores the natural drainage from the marsh surface, and the absence of an open canal eliminates the possibility of saltwater intrusion. Some marsh users, however, do value open canals for fishing and for navigating small boats through wetland areas and would value open-ditch canals. In recognition, however, of the beneficial aspects of canal backfilling, for the past several years the State of Louisiana has required that all new pipeline canals be backfilled.

b. Service Bases

Central Planning Area: Service base locations in the Central Gulf and the waterways that provide access to these bases are indicated in Table IV-7. This table also shows the projected number of service vessel trips to these bases as a result of the Base Case and High Case scenarios. The distribution of vessel trips to the various bases was derived from historical records of service base usage by OCS-related traffic. No new service base construction is projected under the Base Case and High Case scenarios (Table IV-9).

Western Planning Area: Service base locations in the Western Gulf and the waterways that provide access to these bases are indicated in Table IV-7. This table also shows the projected number of service vessel trips to these bases as a result of the Base Case and High Case scenarios. No new service base construction is projected under the Base Case and High Case scenarios.

Eastern Planning Area: Service base locations in the Eastern Gulf and the waterways that provide access to these bases are indicated in Table IV-7. This table also shows the projected number of service vessel trips to these bases as a result of the Base Case and High Case scenarios. No new service base construction is projected under the Base Case and High Case scenarios.

Offshore oil and gas exploration, development, and production require onshore support from bases that serve as the transfer point for materials and personnel. A supply base is used for transferring heavy equipment and supplies (machinery, drilling muds, cement, drilling water, etc.) to boats. It provides facilities for boat dockage, fuel storage, loading/unloading, warehousing, open storage, and parking. Personnel and light equipment disembark from a crew base. Crew bases can be located at the same site as a supply base or at a separate facility. A crew base located at a separate pier includes a pier, parking, and security arrangements at a minimum. Crew and supply bases operate 7 days a week throughout the year (Centaur Associates, Inc., 1985). A service base is assumed to occupy 16 ha (40 ac) of land.

Most of the vessels that transport supplies to the OCS are large vessels that carry an average cargo load of 335 tons, are 55 m long, and have a draft of almost 4 m when fully loaded (Turner and Cahoon, 1987). Crew boats are smaller, averaging 15-30 m in length and requiring a 2- to 3-m draft. See Section IV.A.3.d.(4) for a discussion of service vessels.

Environmental impacts associated with normal service-base use include runoff and spillage of fuels and chemicals from the facility, discharges from supply and crew boats, channel-bank erosion from vessel traffic, and disturbance of bottom sediments and communities if dredging is required to maintain channel navigability. There will be no impacts from new construction activity because no new service-facility construction is projected in support of the leases that may result from the proposed actions.

c. Terminals

Table IV-8 shows that there are 94 terminals currently operating along the Gulf coastline--80 of these are in Louisiana and 14 in Texas. There are no terminals along the Eastern Gulf of Mexico currently receiving OCS produced oil (Table IV-8), and there are no terminals projected for the future (Table IV-9). All oil produced in the EPA is expected to be transported to CPA terminals for delivery to CPA refineries. The infrastructure existing in the CPA and WPA is sufficient to support the Base Case and High Case scenarios for Sales 131 and 135, and no new terminals are projected (Table IV-9).

Terminals are defined as the receiving station for crude oil transported from offshore platforms to shore. Most terminals are the landfall site of a pipeline, where a metering station is located and where storage facilities are expected to be found. At present, there is no tankering of crude-oil from offshore platforms. Therefore, most of the 94 terminals receive oil by pipeline only. Only a few receive oil by barge; the Haymark terminal in Lake Charles, Louisiana, only receives OCS crude by barge. Oil projected to be shuttle tankered may be received by one of these 94 terminals if there are docking facilities present (many already receive imported crude oil tankers) or may go directly to the terminal facilities connected to nearby refineries. For example, crude oil may be shuttle tankered to the Chevron Pipeline Empire Terminal near Venice, Louisiana, and then transported to the Pascagoula refinery via pipeline, or it may be shuttle tankered directly to Pascagoula, Mississippi, and unloaded at the Pascagoula refinery terminal. Some of these terminals receive gas rather than oil. Gas processing plants and separation facilities are often associated with pipeline terminals. Once received, metered, partially processed, and stored at terminals, OCS crude oil is then shipped to refineries via pipeline, barge, or truck.

The size of a terminal and tank farm depends on the production rate of the fields supplying the terminal and the throughput rate of the pipeline(s) serving the terminal, as well as the size of the tankers projected to use the facilities and the number of days it may be necessary to store the oil before throughput. Most of the land required for a terminal and related tank farms for the storage tanks. For example, a 1-million-bbl tank farm capacity requires 7 ha (17 ac) of land and a 35-million-bbl tank farm requires 23.5 ha (58 ac) of land (NERBC, 1976).

Because no new marine terminals are projected to be built as a result of the proposed actions, there will be no impacts from the construction of new marine terminals. Impacts from existing marine terminals result from both air and water routine operational emissions and runoff from the altered terrain. The magnitude of air emissions, as well as all other environmental impacts from the operation of a terminal and the associated tank farm, will depend on the volume of delivery, types of storage tanks used, and operating equipment and procedures.

Sources of air discharges at a terminal include evaporation from storage tanks, evaporation from the transfer of crude oil and fuel, combustion products from process machinery and marine vessels, and accidental small spills and leakage, as well as exhaust emissions from boaters, sumps, and compressors (NERBC, 1976). Marine terminals generate domestic wastewater from employee housing, bilge and ballast waters from vessel traffic, cooling and boiler waters from the generation of electricity, and stormwater runoff.

d. Ports

Gulf Coast ports serving waterborne commerce include some of the busiest in the nation. During 1985, the six Gulf region Customs Districts were responsible for approximately 15 percent of the total imports and exports for the entire United States. Waterborne commerce has maintained a constant presence in the Gulf of Mexico since long before the first oil and gas structures were emplaced. Over the years, an extensive shipping pattern developed in relation to the locations of the major Gulf ports and the Straits of Florida and Yucatan.

Ports only peripherally serve the OCS oil and gas industry. Products needed for storage at nearby supply bases may be first shipped to nearby ports. Marine terminals and service bases often use port docking and berthing facilities. Oil-spill-response equipment may be stored at such ports as Panama City, Florida, or Morgan City, Louisiana. Visuals Nos. 1 and 1E list 35 major ports expected to serve, in some way, the OCS oil and gas program. Also, Section IV.B.3.h. lists ports expected to receive either shuttle-tankered OCS crude oil or imported oil. By state, there are 16 ports in Texas, 9 ports in Louisiana, 3 ports in Mississippi, 1 port in Alabama, and 6 ports in Florida. The channel depths of the major ports receiving crude oil are listed in Figure IV-6.

Impacts from ports depend on the type of facility located in the port area. Sections IV.A.4.b., c., and i. describe impacts from service bases, terminals, and refineries. Section IV.A.3.d.(3) describes impacts from shuttle tankers and barges expected to frequent Gulf ports.

e. Navigation Channels

The OCS oil and gas industry use the extensive waterway system located within the Gulf coastal states to provide access between onshore support operations and offshore platforms and rigs. Vessels moving along coastal navigation channels include crewboats, supply boats, barge systems, derrick vessels, geophysical-survey boats, and floating production platforms to name a few. Section IV.A.3.d.(4) describes the types of support vessels and work barges in more detail. Navigation channels serve as routes for service vessels traveling back and forth from service and supply bases. Also, they may be transversed by barges carrying oil from the OCS or between terminals, may be used for transport of platforms and pipelines, or may provide access to oil spill cleanup equipment stored at coastal ports.

The following navigation channels are used by the OCS oil and gas industry more than 10 percent of the time:

	Base Case	Total Production
Bayou Terrebonne, La.	0.9%	47%
Bayou Lafourche, La.	0.8%	42%
Empire, La. Waterway to Gulf	0.4%	21%
Bayou LaLoutre/ /St. Malo/Yscloskey, La.	0.4%	19%
Vermilion Bay, La., and GIWW 159-160	1.4%	69%
Houma/LeCarpe/Caillou, La.	0.6%	31%
Atchafalaya River, La., and GIWW 79-95	0.7%	33%

The average use of all major navigational channels used for OCS activities projected is as follows:

	Base Case	Total Production
Louisiana	0.2%	12.0%
Mississippi		0.1%
Texas	not available	
Florida	not available	

The following is a list by subanalysis area of all navigation channels that are expected to directly serve the OCS oil industry in some way. The Gulf Intracoastal Waterway, which traverses all states in the Gulf of Mexico, is not listed under any subanalysis area but is expected to serve OCS transport operations.

C1 Calcasieu Ship Channel
Mermentau Navigation Channel
Freshwater Bayou
Vermilion Bay/Bayou Teche

C2 Atchafalaya River
Houma Navigation Canal/LeCarpe/
Caillou Bayou
Bayou LaFourche/Belle Pass
Bayou Terrebonne

E1 Pensacola Ship Channel
Panama City Harbor Ship Channel

E2 Port St. Joe Ship Channel

E3 Tampa Bay Shipping Channels
San Carlos Bay Channel
Ft. Myers Beach Inlet

C3 Caminada Pass
Barataria Waterway
Empire Waterway
Harvey Canal
Bayou Dupre, La.
Tiger/Grand Pass
Mississippi River Gulf Outlet Canal
Mississippi River and Passes
Innerharbor Navigation Channel
La Loutre/St. Malo/Yscloskey

C4 Pascagoula/Bayou Casotte, Miss.
Bayou LaBatre, Ala.
Mobile Bay, Ala.

W1 Brazos Santiago Pass
Port Mansfield Cut
Matagorda Ship Channel
Yarborough Pass
Aransas Pass
Corpus Christi Ship Channel

W2 Freeport Harbor Channel
Houston/Texas City/Gal. Ship Channels
Sabine Pass Ship Channel

The construction and enlargement of navigation channels to support the OCS industry results in both direct and indirect impacts. Turner and Cahoon (1987) analyzed the impacts from dredge-and-fill operations and resulting conversion of wetlands to open water and spoil due to OCS operations in the Louisiana wetlands. Much of the following is taken from this study. A general discussion of the impacts from dredging operations can be found in Section IV.B.4.a. Besides the obvious landloss caused by dredging and spoil-bank-formation operations, landloss occurs due to indirect impacts. Once dredged, navigation channels continue to cause landloss impacts to surrounding wetlands by continuous bank erosion. A spoil bank may act as a hydrologic barrier affecting the movement of water in and out of adjoining wetlands. The OCS navigation channels are normally deeper, straighter, and wider than natural channels and encourage more frequent and severe saltwater-intrusion events. Habitat changes may occur due to associated saltwater intrusion.

The direct impacts of both navigation-channel and pipeline-canal construction accounted for 4-5 percent of the total Louisiana wetland loss from 1955 to 1978. Indirect impacts from channels and canals are estimated to account for 4-13 percent of all wetland loss (Turner and Cahoon, 1987). Wetland loss that could be directly attributed to OCS navigation channels was 2,900 ha (17% of all navigation-channel impacts), of which 2,300 ha were the loss of wetland and beach habitats. The OCS traffic appears to comprise a relatively small percentage of the total commercial traffic using navigation channels; thus, the allocation of navigation channel impacts to OCS activities was small in the Turner study. Direct impacts per unit length of navigation channel are about 20 times greater than OCS pipeline canals; however, the area of all navigation channels is much smaller than that of all the OCS pipelines.

It is estimated that 52 ha are directly lost per kilometer (205 ac/mile) of navigation channel constructed. No new navigation channels are expected to be built as a result of these proposed sales. However, some deepening of existing channels will take place because larger service vessels will be needed to supply the deep-water leases.

f. Pipeline Coating/Storage Yards

The number of existing pipeline coating yards in the Central, Western, and Eastern Gulf is 10, 3, and 0, respectively (Table IV-8). No new pipeline coating yards are projected to be constructed under the Base Case and High Case scenarios (Table IV-9).

These facilities store and coat pipe that will be used for offshore pipelines. The external surfaces of pipes are coated here with metallic, inorganic, and organic materials. These materials protect the pipe from external corrosion and abrasion and add weight with a concrete coating applied to the pipe to counteract buoyancy. Although some pipes are coated on a lay barge as the pipe is being installed offshore, most coating occurs at an onshore facility.

Pipe yards are assumed to occupy 12 ha (30 ac) of land and can store up to 200 km (124 mi) of pipe. Most of the space needs of a yard (up to 95%) are for storing untreated and treated pipe. During some stages of the coating process, treated pipe may have to cure in storage for 3 weeks or more before it can be moved. The yards must be located along a navigable waterway that has an access channel with at least a 4.5-m draft.

The major environmental impacts from pipe-yard operations include water and air discharges from the coating process. Wastewaters from a pipe yard can contain antifouling chemicals and a variety of contaminated process waters. Air emissions containing carbon monoxide, sulfur and nitrogen oxides, and particulates can occur as a result of routine processing operations, from leaks at seals and valves on storage tanks, and from vehicle emissions.

g. Platform Fabrication Yards

The number of platform fabrication yards located in the various coastal subareas in the CPA, WPA, and EPA are 19, 11, and 0, respectively (Table IV-8). No new platform fabrication yard construction is projected for the Base Case and High Case scenarios for the three proposed actions (Table IV-9).

Platforms that are used in the development of offshore oil and gas fields are fabricated and assembled at platform fabrication yards and then towed to their offshore sites for installation. These platforms consist of an above (the deck) and below (the jacket) water component, which may be constructed at the same yard or at different yards. Because of the large size of these structures, access to a large navigation channel is of prime importance in the location of these facilities. As indicated in Table IV-8, the largest number of platform yards occur in coastal subarea C-2, which includes the Atchafalaya River, a large, wide navigable river.

The primary activity at these yards is the shaping, cutting, and welding of the steel components of the offshore structure. Because of the size of the structure being constructed and the need for storage space for large amounts of steel, a platform fabrication yard typically occupies a large amount of coastal land. In this document, each fabrication yard is assumed to occupy 50 ha (124 ac).

The main environmental impacts from the routine operation of these facilities include the discharge of wastewaters and stormwater runoff that may contain heavy metals and particulates and the discharge of air emissions that include sand and metal dust from sandblasting operations, hydrocarbons and organic compounds from paint evaporation, and carbon monoxide and sulfur and nitrogen oxides from equipment and vehicle operations. In addition, solid wastes containing metal scraps and debris will have to be disposed of.

h. Separation Facilities

Table IV-8 lists the subanalysis area locations of the existing 66 separation facilities along the Gulf Coast that handle OCS oil. The vast majority of the existing facilities are located within the Louisiana coastal zone. Figure IV-3 shows the 11 locations of the major OCS-generated produced-water discharges in coastal Louisiana. There also are 16 separation facilities located in these 11 sites. There also are many more facilities that process only State oil (Figure IV-4). Texas, with 11 separation facilities located along its coast, does not allow produced-water discharges within the coastal zone. No new facilities are projected for the Base Case or High Case scenarios of the three proposed sales (Table IV-9). Separation facilities are often located with terminals and/or gas processing plants. About 6 ha (15 ac) are required for each 100,000 bbl of oil and associated gas processed. The 16 major separation facilities located in Louisiana occupy about 3 ha (7 ac) per facility based on this requirement. Average produced-water discharges for each of these major facilities are 31,162 bbl per day, or 45,326 bbl per day at the 11 sites.

Separation facilities, frequently called partial-processing facilities, remove impurities from the crude oil or gas received at the terminal. Crude oil and gas coming directly from an offshore well must be separated and the water removed prior to being processed for final disposition. The liquid components of the well stream are partially processed to remove free and emulsified water, dissolved solids, and suspended solids from the crude oil. Once the crude oil is partially processed, it is delivered to a refinery for conversion into a range of petroleum products. The separation process may begin on the offshore platform and continue with further separation and treatment at onshore processing facilities taking place onshore, or the process may take place totally offshore. Natural gas is often, but not necessarily, removed on the platform and handled at separate facilities.

Impacts from separation facilities occur from construction-site alteration and runoff; air emissions; the discharge of produced waters, cooling and boiler waters, and domestic wastewaters; stormwater runoff; and noise. Because partial-processing facilities are often located with pipeline landfalls, terminals, and gas processing plants, extensive impacts may result from the dredging and fill operations needed for collocated

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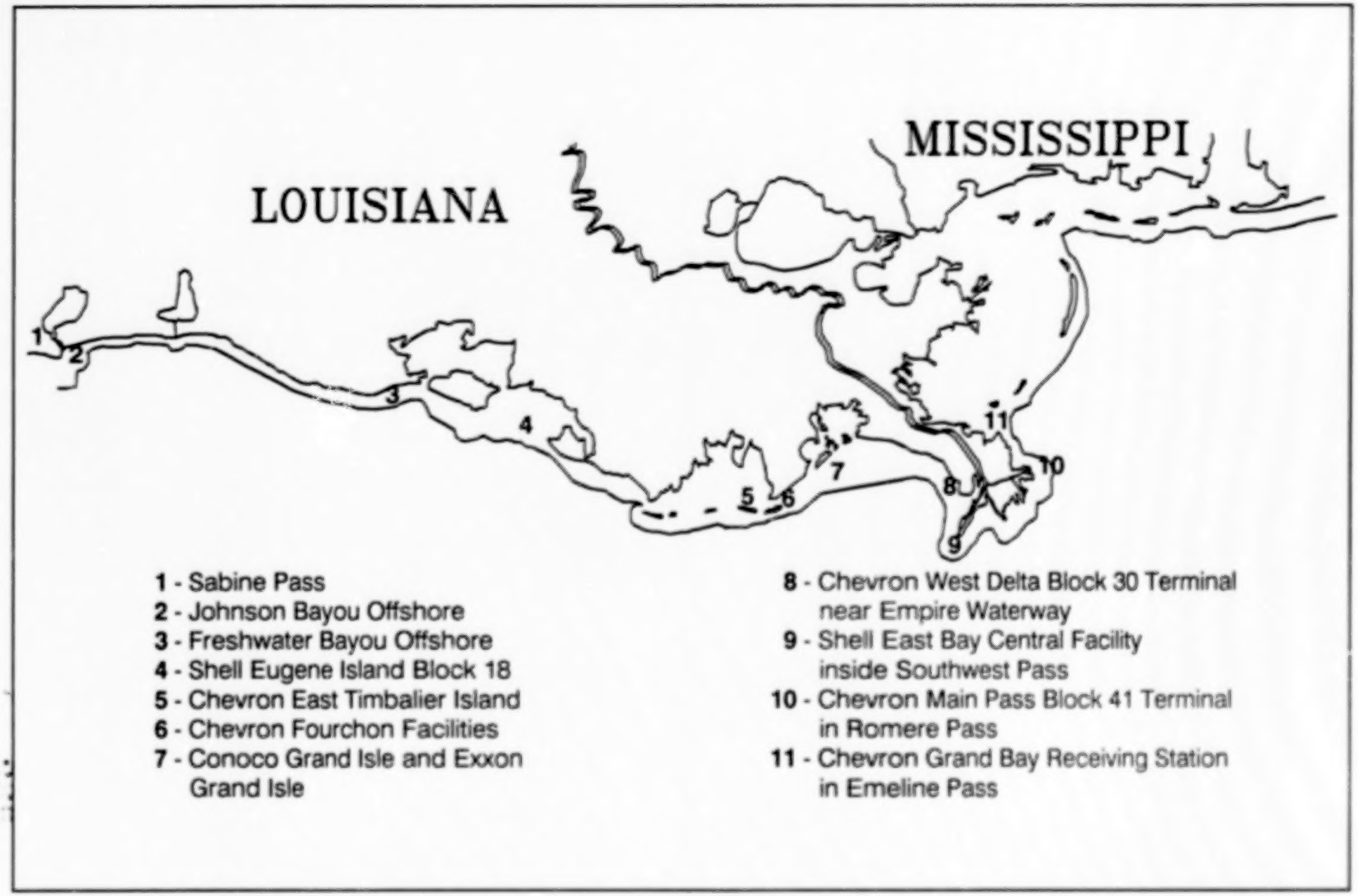
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2 - Johnson Bayou Offshore
3 - Freshwater Bayou Offshore
4 - Shell Eugene Island Block 18
5 - Chevron East Timbalier Island
6 - Chevron Fourchon Facilities
7 - Conoco Grand Isle and Exxon Grand Isle
8 - Chevron West Delta Block 30 Terminal near Empire Waterway
9 - Shell East Bay Central Facility inside Southwest Pass
10 - Chevron Main Pass Block 41 Terminal in Romere Pass
11 - Chevron Grand Bay Receiving Station in Emeline Pass

Figure IV-3. Locations of Major OCS-Generated Produced Water Discharges in Coastal Louisiana (Boesch and Rabalais, 1989a).

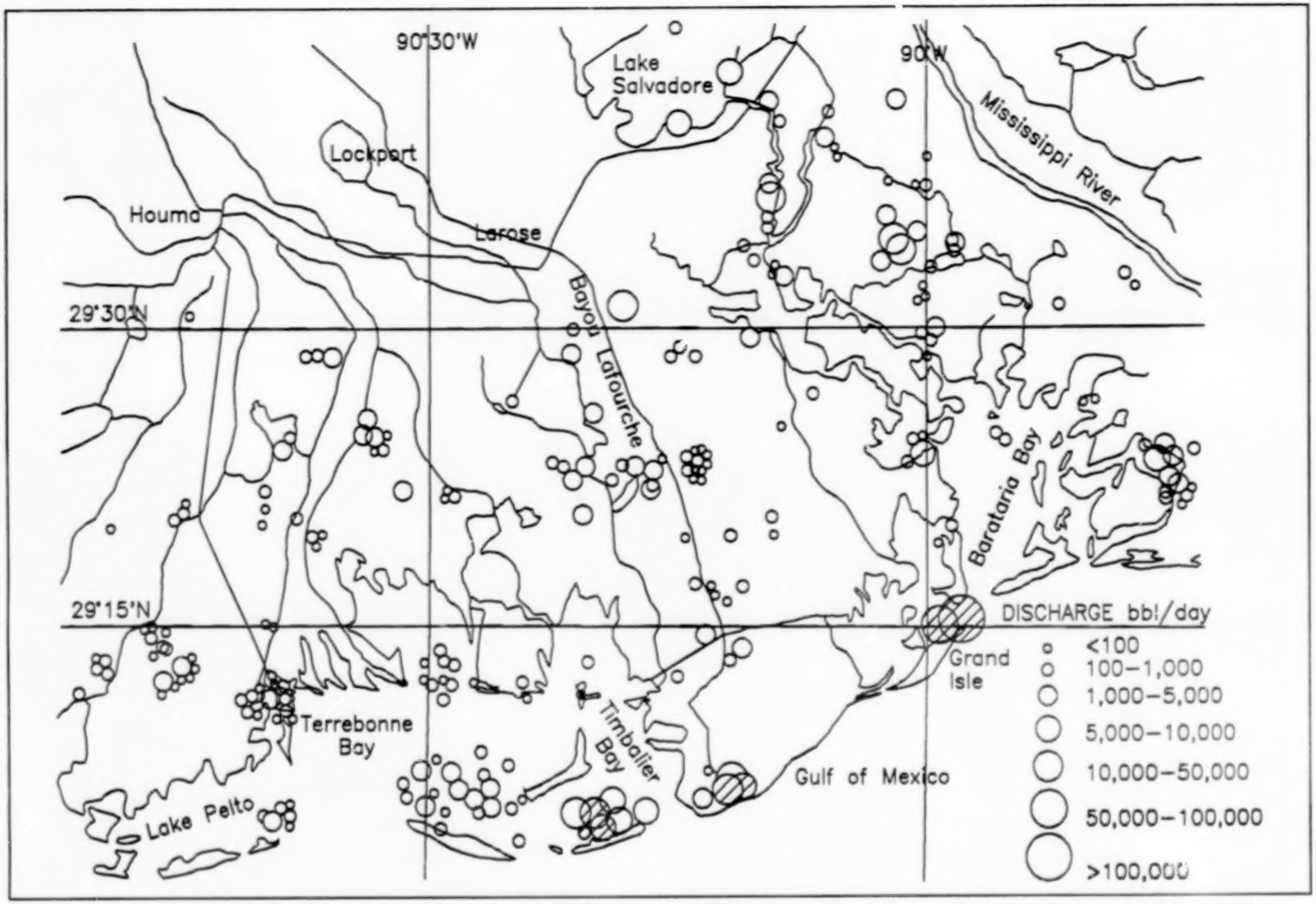

Figure IV-4. Locations of produced water discharges in Louisiana's Terrebonne and Barataria estuarine systems; hatched circles represent OCS-generated produced water (Boesch and Rabalais, 1989a).

facility siting. Hydrocarbons, hydrogen sulfide, sulfur oxides, and nitrogen oxides are the primary types of air emissions. Sources include evaporation from surge and storage tanks, combustion products from process machinery and vehicles, and leakage at valves and seals. Impacts from produced waters and a description of the contaminants in produced waters can be found in Sections IV.A.3.e.(2) and IV.A.4.k.(1). Other water-quality contaminants discharged include suspended solids, oil and grease, heavy metals, phenols, halogens, and chromium. Noise levels can be as high as 96 db from flare stacks and treating vessels.

i. Refineries

The number of existing refineries in the Central, Western, and Eastern Gulf are 18, 20, and 0, respectively (Table IV-8). No new refinery construction is projected as a result of the Base Case and High Case scenarios (Table IV-9). Sufficient excess refinery capacity exists in the area to accommodate OCS production from the proposed actions. Furthermore, because of the large capital expenses of establishing a new refinery, it is likely that, if needed, additional refinery capacity in the Gulf will be provided by expanding the capacity of existing refineries rather than constructing new facilities.

The distribution of refineries in the Central Gulf by coastal subarea is fairly uniform (Visual No. 1). There is a slightly higher concentration of refineries in subarea C-3, which includes the Mississippi River, a major waterway for oil tankers. Most of the refineries in the Western Gulf are located in subarea W-2, which includes the Houston-Galveston area, the largest crude oil/petrochemical refinery complex in the United States.

A refinery separates the naturally occurring components of crude oil into marketable products such as diesel fuel, lubricating oil, and gasoline. The refining process includes a number of interdependent operations that receive crude oil, separate it into components, and blend the components into petroleum-derived products. Large tracts of land are needed for a refinery to allow sufficient space for expansion and a buffer zone. Factors that are considered in locating a refinery site are the availability of large quantities of water and the accessibility of nearby deep-water facilities for large crude-oil carriers.

In the Gulf of Mexico area, oil is delivered directly to refineries from the OCS via pipeline or barge, or is first delivered to an oil terminal via pipeline or barge and then is piped, barged, or trucked to a refinery. Barge traffic makes extensive use of the Intracoastal Waterway and other inland waterways for transporting oil from terminals to refineries.

Impacts from routine refinery operations include visual and aesthetic degradation; air emissions including particulate matter, nitrogen and sulfur oxides, carbon monoxide, and volatile hydrocarbons; and wastewater discharges that include hydrocarbons, alkaline substances, particulates, and metal fragments. In addition, the unloading of barges and trucks at a refinery introduces the chance of an accidental oil spill. In 1988, total OCS oil production accounted for only 12 percent of the utilized capacity of the refineries that process some OCS oil.

j. Gas Processing Plants

The number of existing gas processing plants in the Central, Western, and Eastern Gulf are 46, 36, and 1, respectively (Table IV-8). The high concentration of processing plants in the westeran part of the Central Gulf (coastal subareas C-1 and C-2) is the reulst of the occurrence of gas prone tracts in the western part of the Central Gulf OCS. The one gas processing plant in the Eastern Gulf is located in Jay, Florida, in Santa Rosa County.

Gas processing plants remove impurities from raw gas to preset standards of the purchasing utility before the gas is commercially distributed. Sometimes some initial processing of the gas takes place at the production platform to remove oil and/or water prior to reaching the processing plant. Some processing plants are constructed to also recover certain saleable natural gas liquids such as butane, propane, ethane, and natural gasoline from condensate if these components are present in quantities that make extraction economically feasible. Liquids are removed from the gas stream by a process that cools the gas through refrigeration or through a lean-oil-absorption process. A gas plant can be located either at the shore or farther inland. A site near the coast is preferred because the greater distance that offshore gas travels through a pipe the more cooling will occur, and cooling can lead to the formation of hydrates in the line that can obstruct the gas flow. Gas is delivered to and transmitted from processing plants via pipeline.

Land requirements for a gas processing plant are usually not large. Estimates are that a 1 mmft^3/day facility requires 20-30 ha (50-75 ac). There are no standard sizes or designs for a gas plant, however, because the plant is specifically designed for the particular gas stream that it processes. The lifespan of a plant is usually 10-20 years, depending on the longevity of the gas reserves that are being processed. No new gas processing plants are projected to be constructed during the 39-year life of the proposed action. In 1989, 79 percent of the utilized capacity of gas processing plants in the Gulf area processed OCS gas. The primary environmental effects of a gas processing plant include gaseous, liquid, and solid-waste discharges. Primary air emissions include sulfur and nitrogen oxides, hydrogen sulfide, carbon monoxide, volatile hydrocarbons, and particulates. Wastewater discharges can include dissolved hydrocarbons; sulfuric acid; and chromium, zinc, phosphate, and sulfite compounds. Solid wastes are composed of sludges, scales, spent desiccants, filtration media, and oil absorbents.

k. OCS Onshore Discharges and Emissions

(1) Produced Waters

Much of the water produced in oil and gas operations on the OCS are discharged directly from offshore production platforms into surrounding waters. However, some is piped ashore first and then discharged into nearshore or estuarine waters. Section IV.A.3.e.(2) presents a detailed discussion of produced-water characteristics. Statistics produced from a Boesch and Rabalais (1989a) study determined that 37 percent of the produced water generated in the OCS was piped ashore for separation and disposal in Lousiana coastal waters during the time period examined (1983-1986). Approximately 22 percent of all the produced waters discharged into Louisiana waters come from OCS operations. The study also determined that no OCS produced water is being discharged into other States' coastal waters. The table below is taken from Boesch and Rabalais (1989a):

Historical Produced-Water Discharges into the Gulf of Mexico Region
(time period 1983-1986)

	OCS Offshore Disposal	OCS Coastal Disposal	Louisiana (within State)	Texas (within State)	Total
Volume (bbl/day)	745,228	434,772	1,524,962	735,854	3,440,816
Percentage	22%	13%	44%	21%	

Source: Boesch and Rabalais, 1989a.

Based on the results of this study, amounts of produced waters are projected to be discharged onshore due to Sale 131 and due to not-yet-produced oil and gas from past sales and future sales. These are presented in Table IV-1. The MMS assumes that all produced waters discharged into Louisiana waters are generated in the CPA. The amount projected to be discharged into Louisiana coastal waters for Sale 131 during the 39-year life of the proposed action is 413 million bbl, or 29,013 bbl/day. The amount projected to be discharged in coastal waters from development occurring during the 39-year life of the proposed action from past and future sales, as well as Sale 131, is 20.33 billion bbl, or 1.43 million bbl/day.

A number of studies have examined the effects of produced waters discharged in coastal habitats. In Trinity Bay, Texas, total resolved hydrocarbons in produced waters were diluted by 2400-fold within 15 m downcurrent from the discharge source (Armstrong et al., 1979). However, Armstrong et al., examining a shallow estuarine system, found a zone of severely depressed benthic fauna out to about 250-350 m from the discharge point. High salinity appeared to be responsible for reduced white and brown shrimp and blue crab production in some tertiary bays in the Aransas system also studied in Texas (Knecht, 1988).

A review of produced water impacts to Louisiana estuarine communities was recently completed by A.T. Knecht of the University of New Orleans (1988). He found a few studies dealing with the subject; the following summarizes his conclusions. The first investigation he discussed took place from 1946 to 1949 at the Lake Barre Field in Louisiana. While the results were inconclusive, the researchers found that produced water increased oyster mortality within approximately 23 m of the discharge. Growth of oyster spat was also inhibited at distances up to 45.5 m of the platform. Other studies in the 1950's documented the presence of substantial quantities of "oil" in bottom sediments in narrow canals that were receiving produced waters near the LaFitte Field. The Offshore Ecology Investigation by the Gulf Universities Research Consortium was conducted from 1972 to 1974 and found no discernible adverse effects on any of the organisms studied from oil and gas activities. However, Dr. Knecht notes, as do most investigators of the study, that any damage would have been difficult to detect because of the extreme environmental fluctuations. One of the most comprehensive studies was conducted by Neff et al. (1988) at the Lake Pelto Field in Louisiana. Dr. Knecht states that the study contains extensive data on the composition of produced waters, affected sediments, and associated benthic fauna. The accumulation of hydrocarbons in sediments near the platforms was reported. The benthic fauna appeared normal throughout the test area, except within 20 m of the platform (Knecht, 1988).

Two recently completed studies (Boesch and Rabalais, 1989a and b) examined sites in coastal Louisiana that were receiving produced-water discharges and reached the following conclusions: The mean salinity of estuarine receiving-waters did not increase by more than a few percent due to presently occurring produced-water discharges. Trace metals, except for barium, did not show a consistent pattern of enrichment in sediments near produced water discharges. However, impacts due to organic pollution were found. Substantial petroleum-hydrocarbon contamination of the sediments near the discharge sites were occurring at many locations. Polynuclear-aromatic-hydrocarbons in the sediments exceeded background levels by over an order of magnitude (Boesch and Rabalais, 1989a). Contaminated sediments extended several hundred meters to over 1 km from the discharge point. Benthic organisms were present in reduced densities and reduced diversity of species where there were high to moderate contamination of sediments by petroleum hydrocarbons (polynuclear-aromatic-hydrocarbons levels over 1,000 ppb) (Boesch and Rabalais, 1989b). Filter-feeding bivalves in the proximity of the discharge sites had accumulated petroleum hydrocarbons in their tissues.

The wetland vegetation studied had been extensively modified by canal construction. Impacts due to produced-water discharges were therefore difficult to separate from impacts due to hydrological modifications. Either there were no effects found on marsh vegetation loss or, at the least, the effect was very small in comparison to the effect of canal construction in the areas examined (Boesch and Rabalais, 1989b) and therefore not discernable. The effects of the OCS-related discharges were more extensive than reported for other produced-water discharges because of the lower physical dispersion in the bayous and canals into which the discharges take place and the larger volumes of produced water discharged (Boesch and Rabalais, 1989a).

An ongoing MMS study is further examining the impacts of OCS produced waters in Louisiana coastal areas. The study began fieldwork in 1988 and will continue with the program design of Boesch and Rabalais (1989a). However, it will elucidate, in finer scale, more details of the determined impacts. More sampling is occurring around the three previous sites as well as at nine new sites. Sampling includes measurements of constituents along gradients extending from the sites, analysis of hydrogen-sulfide and radionuclide concentrations, and water-current measurements to aid in the characterization of plume dispersion. Overflights are being used to examine broader scale impacts.

(2) Onshore Nonpoint and Point Source Discharges

The construction and operation of onshore facilities supporting OCS activities in the Gulf may impact local onshore water quality by routine point and nonpoint source pollution and by accidental discharges. A description of the onshore support facilities is presented in Section IV.A.4.

Construction of these onshore support bases and ancilliary access facilities contribute to onshore water quality degradation. Construction activities and all associated hydrologic modifications would result in some runoff and other nonpoint source pollution to the surrounding waterbodies. Navigation channels and canals and other waterbodies may be diked, leveed, or impounded; piers, bulkheads, and beach-stabilization actions may be undertaken. To construct the support facility, the site must be prepared, roadways and bridges may need to be built, sewage and stormwater systems installed, and groundwater or adjoining waterbodies accessed for water use. During preparation, the vegetation is cleared from the area, the topsoil is exposed, and the soil profile is altered by grading and leveling operations. The soil is compacted by the constant movement of heavy machinery, which in turn alters the retention properties of the soil and gives rise to increased erosion and runoff from the site. Land clearing and associated development changes the natural process of stormwater runoff, causing the volume and rate of runoff to increase as the natural vegetation is modified.

Once constructed, the facility's presence, along with access routes, continues to alter the natural hydrology and geography of the area. The volume and rate of stormwater runoff will remain greater than before construction; saltwater intrusion may occur; and, with existing vegetation modified, greater erosion around the facility may take place.

Increases of nonpoint source pollution due to runoff at support facilities may contribute particulate matter, heavy metals, petroleum products, chemicals, and radionuclides (particularly from pipe yards) to local streams, estuaries, and bays, causing temporary elevations in pollutant and turbidity levels. Two major pollutants are contained in this runoff--suspended solids (organic and inorganic) from exposed soil at the site and contaminants such as heavy metals. Suspended solids may significantly decrease light penetration in water, thereby decreasing photosynthesis in aquatic plants. These may also cause abrasive injuries and gill clogging in fish and can smother eggs and larvae on the bottom. They may provide additional substrates for bacterial decay, leading to oxygen depletion of bottom waters. Alternately, they may contain nutrients, which increase growth rates of endemic plant and animal populations.

Impacts of heavy metals or other contaminants contained in runoff on receiving waters will depend upon two factors. The first is the nature of the runoff and the level of concentration of heavy metals. The second factor is the nature of the receiving waters and the diversity of the species. Some heavy metals are extremely toxic, even in low concentrations, while others have a cumulative effect as organisms ingest them. As in the case of shellfish water quality, changes may not kill the resource but may contaminate, making it unsafe for use as a human food source, or they may taint the flavor of the source, making it undesirable for human consumption. These metals also may exhibit a toxic effect on consuming organisms higher in the food chain due to concentration increases at each step in the food chain (NERBC, 1976).

Besides nonpoint source water-quality problems resulting from the construction and physical presence of onshore facilities, many of the support bases contribute a number of routine and accidental point source discharges to the surrounding waterbodies. At service bases and marine terminals, hydrocarbons and other pollutants are discharged in the bilge and ballast waters of support vessels docking at these facilities. The bases and support vessels also contribute contaminants through their use of antifouling marine paints and through accidental oil-spillage events and the release of heavy metals and contaminated sludge. Pipecoating yards, platform-construction facilities, and repair and maintenance yards contaminate surrounding waters by releasing thermal effluents, radioactive substances, antifouling paint chemicals, heavy metals, and a variety of process waters, as well as solid waste such as packaging materials, metal scraps, and other debris. Gas processing plants and refineries discharge a number of types of wastewaters, including cooling and boiler waters, sanitary and domestic wastewaters, and process waters. These waters may be contaminated with dissolved hydrocarbons, sulfuric acid, chromium, zinc, phosphates, alkaline substances, and suspended solids. The following discussion on wastewater effluents discharged to surface waters by OCS-related support facilities is largely taken from NERBC (1976).

Wastewater effluents from OCS-related support facilities are commonly discharged to surface waters after treatment. Although the degree of environmental damage, if any, is related directly to the toxic nature of the discharge and the biota in the receiving waters, certain characteristics of the discharge zone are important. These include the size of the effective mixing zone (dilution factor) or the ratio of discharge volume to receiving volume, the flushing rate of residence time (estuaries characteristically have a slow flushing rate), and the physical-chemical characteristics of the receiving waters (e.g., marine waters have a higher buffering capacity than fresh or estuarine waters).

Cooling water represents a significant proportion (70%-100%) of the wastewater effluent from an oil refinery or gas processing plant. Substances concentrated in the blowdown and heat added during the condenser cooling operations could produce serious impacts on the receiving waters. Chemicals added to the cooling water stream to reduce corrosion and fouling within the tower and the condenser system (including chromium and chlorine) may be extremely toxic to aquatic organisms. The presence of these substances could increase any adverse impacts of heated discharge on the receiving waterbody.

Domestic wastewater from support facilities will be collected and delivered to a municipal treatment plant or will receive secondary treatment in an onsite package treatment plant that includes chlorination prior to discharge to the receiving waters. Receiving waters that also contain high will produce organic carbon concentrations will produce organic chlorine compounds (e.g., chloroform and chloramines), which are highly toxic to certain aquatic organisms.

Although it does not constitute the greatest volume of water used in refining operations, process water may be the most contaminated. The processing pollutants are added during crude-oil desalting, steam distillation, steam stripping, etc. In general, the quantity and hazardous nature of process water is a function of the size of the facility (in terms of barrels/day) and the degree of processing. Process water discharged from plants is of considerable volume and is highly toxic due to its anaerobic and highly reduced character and the presence of numerous heavy metals (primarily three toxic metals--mercury, cadmium, and cyanide), sulfides, and ammonia, which are produced together with the oil and gas.

Wastewater effluents from OCS-related facilities produce a wide range of responses in the receiving waters. Environmental responses produced will depend upon the quantity and kind of pollutants discharged or spilled. Heavy metals (such as zinc or copper), although often essential or nontoxic to organisms in very low concentrations, become toxic in higher concentrations. Even if the concentration of a heavy metal in the water is not toxic, it may accumulate in tissues with ultimately lethal effects. Ammonia can alter the pH of water, thus harming pH-sensitive organisms. Antifouling substances, which are added to cooling water to kill algae and bacteria, have similar effects on the organisms present in the water into which they are discharged. Suspended solids significantly decrease light penetration into the water, thus decreasing photosynthesis in aquatic plants. They also cause abrasive injuries and gill clogging in fish and can smother eggs and larvae by blanketing a stream bottom. Suspended solids that settle on the streambed provide additional substrates for bacterial decay, leading to oxygen depletion of the bottom waters. Thermal discharges can alter the chemical nature of receiving waters in many ways. Solubility of dissolved oxygen, toxicity of heavy metals, and metabolic rates of aquatic organisms are affected by changes in water temperatures.

The environmental impacts associated with oil and heavy-metal pollution in the marine environment include both toxic and sublethal responses. Juvenile forms of many species of marine fauna are particularly sensitive, and an age class may be totally eliminated by a specific dosage of oil or some heavy metal. Sublethal physiological alterations include depression of growth and photosynthesis in marine flora.

Onshore point source discharges will be subject to treatment by municipal and industrial facilities in compliance with Federal and State discharge permit requirements. On the Federal OCS, a general permit has been issued for oil- and gas- extraction activities; whereas onshore, NPDES permits are issued on a facility-by-facility basis, limiting the quantities of contaminants in and the temperature of each facility's effluent. These limits reflect a site-by-site specific analysis of flushing- and mixing-zone rates of the receiving body and the indigenous population's ability to tolerate elevations of temperature and pollutant concentrations.

(3) Air Emissions

In the onshore environment, potential impact-producing activities include the operational emissions from oil refineries, gas processing plants, and vessel offloading. Catastrophic events occurring on the OCS rarely impact the onshore environment because of the distance-to-shore factor, dispersion characteristics, and infrequency of events.

Gulfwide oil refineries process oil from domestic and foreign sources. Domestic sources include both offshore and onshore locations. Offshore production accounts for slightly over 2 percent of oil-refinery capacities of the region. Gas processing plants in the Gulf secure 64 percent of their capacity from offshore sources. This includes gas produced in State offshore locations. Emissions resulting from the processing of oil and gas onshore in the Gulf of Mexico are within the authority and control of State agencies.

B. CUMULATIVE SCENARIO

The cumulative scenarios support the cumulative analyses, which assess future impacts (occurring subsequent to the proposed actions over the period 1991-2029) to the identified resources of concern. These scenarios provide data, information, and assumptions necessary for estimating the number and characteristics of potential impact-causing events that could result from construction, operation, maintenance, deactivation, and removal activities related to the following: the proposed OCS oil and gas sales; subsequent OCS oil and gas sales that are considered reasonably foreseeable; prior OCS sales; and other major non-OCS activities and occurrences.

1. Regional Development Scenario and Exploration, Production, and Transportation Assumptions for the OCS Leasing Program

a. Resource Estimates and Development Scenario

Tables IV-1, IV-2, and IV-3 present a summary of the major OCS-related elements in the cumulative scenarios for the proposed actions in the Central, Western, and Eastern Gulf, respectively. Data shown for all OCS sales represent the results of OCS activity projected to occur during the 39-year life of the proposed action as a result of lands leased in prior sales, the proposed sales, or future sales. Thus, activity that takes place beyond this 39-year timeframe due to future sales is not included in this analysis. There are a number of other components of the cumulative scenario (not included in the summary tables) that are also considered in the impact analyses, and these components are discussed in the following sections.

b. Lease Development and Production Schedule

Central Planning Area: Estimates of total resource production related to the proposed action plus prior and future sales in the planning area over the period 1991-2029 are 6.41 billion bbl of oil and 54.71 tcf of gas. It is projected that during this period approximately 95 percent of the total oil and gas resources and reserves available in the CPA at the time of the proposed sale are produced. To discover and develop these resources will require the drilling of 4,600 exploration and delineation wells, the emplacement of 265 production platforms, and the drilling of 4,980 oil and gas development wells (Table IV-1).

Western Planning Area: Estimates of total resource production related to the proposed action plus prior and future sales in the planning area over the period 1991-2029 are 1.21 billion bbl of oil and 25.67 tcf of gas. It is projected that during this period approximately 70 percent of the total oil and gas resources and reserves available in the WPA at the time of the proposed sale are produced. To discover and develop these resources will require the drilling of 3,480 exploration and delineation wells, the emplacement of 165 production platforms, and the drilling of 1,980 oil and gas development wells (Table IV-2).

Eastern Planning Area: Estimates of total resource production related to the proposed action plus prior and future sales in the planning area over the period 1991-2029 are 0.37 billion bbl of oil and 0.82 tcf of gas. It is projected that during this period approximately 39 percent of the total oil and 49 percent of the total gas resources and reserves available in the EPA at the time of the proposed sale are produced. To discover and develop these resources will require the drilling of 680 exploration and delineation wells, the emplacement of 55 production platforms, and the drilling of 430 oil and gas development wells (Table IV-3).

c. Transportation Assumptions

Statistics on historical transportation of oil and gas in the Gulf of Mexico due to OCS activity and on transportation assumptions for the Base Case and High Case of Sales 131/135/137 are provided in Tables IV-1 through IV-3. These tables also provide assumptions for all future OCS activity due to past sales, present sales, and future sales. Section IV.A.3.d. provides a general description of shuttle tankers, pipelines, and barges and the impacts that could occur due to their use.

Shuttle tankering will continue to be a viable alternative to the choice of pipelines in deeper waters (Section IV.A.3.d.). The following describes the projected use of shuttle tankering in support of all future OCS operations occurring during the 39-year life of the proposed action for the three planning areas: 0.1 percent of oil produced in the CPA, 10.5 percent in the WPA, and 93.3 percent in the EPA will be shuttle tankered to onshore terminals. For all future activity, 48 shuttle-tanker trips of 20,000-dwt tankers are expected in the CPA, 955 trips of 20,000-dwt tankers are expected in the WPA, and 1,037 trips of 50,000-dwt tankers are expected in the EPA, with 42 occurring in the peak year (Tables IV-1 through IV-3). Table IV-10 proportions the number of trips expected in each analysis area and shows that analysis areas C-1, C-3, W-1, and E-4 are expected to be the origins of the majority of shuttle tanker trips. The number of trips of shuttle tankers to each port occurring due to all future OCS activity is projected in Table IV-6.

The barging of oil is expected to continue in a similar mode to present activities and, therefore, is expected to be 3 percent in the CPA and WPA. No oil is expected to be barged in EPA waters under the cumulative scenario. Tables IV-1 through IV-4 and IV-10 provide information on the number of trips expected in each planning area and each subanalysis area. Barging is only expected to occur in those portions of the analysis areas in shallow water or near State waters. Table IV-6 shows the amount of barging once the barges reach coastal waters along major navigation channels to the major terminals that receive barged oil.

The vast majority of the oil will be piped ashore, relying on the ever-expanding existing pipeline network. As of August 1989, the cumulative length of OCS pipeline in the WPA and the CPA is 30,663 km (Tables IV-1 and IV-2). Currently, no pipelines have been built in the EPA. The installation of new offshore pipeline segments on the OCS will be needed to support all OCS operations during the 39-year life of the proposed action in order to connect new production platforms to existing pipeline systems or to establish new trunklines for bringing production from areas with previously undeveloped resources to shore. In the Western Gulf, three new oil trunklines are projected to bring oil from offshore the southern Texas coast to land. These trunklines will occur in W-1 (two lines) and W-2 (one line) (Table IV-10). There are currently no oil pipelines in analysis area W-1. The establishment of these trunkline systems will require 1,518 km of new pipelines. In addition to the installation of new pipeline systems, offshore gathering lines from new production platforms to existing pipelines or central platform facilities are assumed to be installed for all future OCS production. A total of 3,508 km of gathering lines are expected to be installed in the WPA during the 39-year life of the proposed action.

One new pipeline system is projected for the CPA and 4,014 km of gathering lines are expected to be installed for future OCS activities. The new pipeline system will be 1,937 km of pipeline and will transport gas from offshore Alabama into Mobile Bay in analysis area C-4. Two new pipeline systems--one oil and one gas--are projected for the Eastern Gulf. These trunklines are expected to be installed to support activities occurring from a previous sale (81/84). These two systems will transport the gas and oil from the western part of the Eastern Gulf offshore the Florida panhandle (analysis area E-1) to the Mobile, Alabama, and Pascagoula, Mississippi, areas. Also projected is the installation of 780 gathering lines to connect platforms to the proposed systems. Table IV-10 provides the kilometers of all pipelines (both gathering and trunk) in each analysis area.

Besides the transportation of oil and gas ashore, supplies, services, and personnel must be transported by boats and helicopters to OCS oil and gas structures. Section IV.A.3.d.(4) provides a description of these activities, as well as their expected impacts, and also provides tables that show the movement of support/service vessels to and from service bases during all future OCS operations.

d. Offshore Infrastructure Description and Estimates

Existing offshore infrastructure related to the oil and gas industry is highly concentrated in the CPA and WPA. To date, only OCS exploration activities have taken place in the Eastern Gulf of Mexico. The major types of impact-producing offshore structures considered in the analyses include exploration and delineation wells, platforms, development wells, and pipelines. Tables IV-1, IV-2, and IV-3 provide estimates of existing structures, actual 1988 installations, and projected installations for the CPA, WPA, and EPA, respectively.

A summary of the offshore infrastructure required to explore, develop, and produce oil and gas resources projected to result from prior, proposed, and future sales in all Gulf of Mexico OCS lands during the 39-year

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Table IV-10

Projected Impact-producing Factors Over the Life of the Proposed Sales (1991-2029) by Offshore Subplanning Area*
(All OCS Sales)

Central Gulf - Offshore Subplanning Areas

Offshore (total/peak year)	C1 All OCS Sales	C2 All OCS Sales	C3 All OCS Sales	C4 All OCS Sales	Total Central All OCS Sales
Exploration and Delineation Wells	1,242 / 76	2,024 / 123	1,196 / 73	138 / 8	4,600 / 280
Platform Installations	72 / 5	116 / 8	69 / 5	8 / 1	265 / 19
Development Wells	1,345 / 84	2,191 / 136	1,295 / 81	149 / 9	4,980 / 310
Pipeline Length (km)	1,084 / 168	1,766 / 281	1,044 / 159	2,257 / 327	5,951 / 935
Shuttle Tanker Traffic (trips)	0 / 0	10 / 0	38 / 2	0 / 0	48 / 2
Barge Traffic (trips)	4,636 / 202	0 / 0	4,465 / 194	514 / 23	9,615 / 419
Service Vessel Traffic (1,000 trips)	59.13 / 2.43	96.36 / 3.96	56.94 / 2.34	6.57 / 0.27	219 / 9

Western Gulf - Offshore Subplanning Areas

Offshore (total/peak year)	W1 All OCS Sales	W2 All OCS Sales	W3 All OCS Sales	Total Western All OCS Sales
Exploration and Delineation Wells	1,218 / 82	1,044 / 71	1,218 / 82	3,480 / 235
Platform Installations	58 / 4	50 / 3	57 / 3	165 / 10
Development Wells	693 / 33	594 / 29	693 / 33	1,980 / 95
Pipeline Length (km)	2,241 / 359	1,557 / 247	1,228 / 192	5,026 / 798
Shuttle Tanker Traffic (trips)	551 / 21	0 / 0	404 / 15	955 / 36
Barge Traffic (trips)	977 / 37	838 / 32	0 / 0	1,815 / 69
Service Vessel Traffic (1,000 trips)	44.80 / 1.75	38.40 / 1.50	44.80 / 1.75	128 / 5

Eastern Gulf - Offshore Subplanning Areas

Offshore (total/peak year)	E1 All OCS Sales	E2 All OCS Sales	E3 All OCS Sales	E4 All OCS Sales	Total Eastern All OCS Sales
Exploration and Delineation Wells	218 / 12	14 / 1	95 / 5	353 / 20	680 / 38
Platform Installations	18 / 1	1 / 0	8 / 1	28 / 2	55 / 4
Development Wells	138 / 5	9 / 0	60 / 2	223 / 10	430 / 17
Pipeline Length (km)	856 / 225	16 / 4	109 / 29	406 / 106	1,387 / 364
Shuttle Tanker Traffic (trips)	20 / 1	18 / 0	213 / 9	786 / 32	1,037 / 42
Barge Traffic (trips)	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
Service Vessel Traffic (1,000 trips)	9.60 / 0.32	0.60 / 0.02	4.20 / 0.14	15.60 / 0.52	30 / 1

Shown Figure IV-1.

Source: USDI, Minerals Management Service, Gulf of Mexico OCS Region, 1989.

life of the proposed action can also be found in Table IV-10. In addition, this table provides a breakdown of these impact-producing factors by offshore subarea. Note that no activity is projected for the Eastern Gulf offshore subarea E-5.

e. Onshore Infrastructure Description and Estimates

A description of the major types of onshore infrastructure related to the exploration, development, and production of oil and gas resources can be found in Section IV.A.4., which provides--for each facility type-- a generic discussion of the facility's function, average size, potential impacts, and land-use requirements.

The central and western portion of the Gulf of Mexico has one of the highest concentrations of oil and gas activity in the world. This high level of oil- and gas-related activity is accompanied by extensive development of onshore service and support facilities. The major types of impact-producing onshore infrastructure include gas processing plants, navigation channels, oil refineries, pipelines and pipeline landfalls, pipecoating and storage yards, platform-fabrication yards, separation facilities, service bases, and terminals. A summary of the existing OCS-related onshore facilities by coastal subarea can be found in Table IV-8. In addition, Visuals Nos. 1 and 1E indicate the location of several of these facilities, both graphically and in tabular format. The tabular format on the back of the visuals includes the company name, capacity, and location of most gas processing plants and refineries.

It is expected that the vast majority of the onshore service, support, and hydrocarbon-processing facilities already in existence will be sufficient to explore, develop, and produce oil and gas resources projected to result from prior, proposed, and future sales for all Gulf of Mexico OCS lands. Tables IV-6 and IV-7 provide in-house MMS estimates of terminal and service base usages in support of all OCS sales. In addition, Section IV.A.4.c. provides aggregate-usage information for navigation channels in all three planning areas. The percentage of utilized capacity of the onshore facilities listed in Table IV-8 supporting OCS activities for the past several years was examined. Based on this review, it is assumed, for analysis purposes, that there will be about a 90 percent use of these facilities in support of future OCS operations.

Even though most existing facilities have sufficient capacity to support the projected level of offshore activity, in some cases additional onshore service operations will be established and require the reactivation of inactive facilities and/or the construction of new ones. Table IV-9 lists the major types and number of additional/new facilities required in support of aggregate future Federal offshore exploration, development, and production in the Gulf of Mexico. This table also provides potential locations for these new facilities at the coastal subarea level.

Central Planning Area: All new facilities projected for the CPA will be located in coastal subarea C-4, the Mississippi-Alabama Gulf Coast. No new facilities are projected for coastal subareas C-1, C-2, or C-3. Prior sales will account for the installation of 48 km of onshore pipe and three new pipeline landfalls in the CPA. Two of these pipelines will be used to transport gas and one to transport oil. In addition, coastal subarea C-4 will also be the potential site of a new pipeyard, two new separation facilities, and three new terminals.

A very minor portion of facilities in the CPA are expected to support oil and gas activities in the EPA. Low oil- and gas-resource projections for the Eastern Gulf do not, in themselves, justify the location of service and support facilities in that area.

Western Planning Area: New facilities projected for the WPA are widely distributed throughout the Texas Gulf Coast. Prior sales will account for the installation of 121 km of onshore pipe and three new pipeline landfalls in the WPA (Table IV-9). Two of these pipelines will be used to transport oil and one to transport gas (2 in W-1 and 1 in W-2). In addition, the WPA will also be the potential location for one new pipe yard (W-1) and three new terminals (2 in W-1 and 1 in W-2).

Eastern Planning Area: No new facilities or onshore pipelines are projected for the EPA. Low oil- and gas-resource projections for the Eastern Gulf do not, in themselves, justify the location of service and support facilities in that area. The limited oil and gas activity expected in the Eastern Gulf will likely be supported by existing facilities in the EPA and CPA, as well as new facilities along the Mississippi-Alabama Gulf Coast.

2. State Offshore Oil and Gas Activities

Comprehensive information on oil and gas activities in State waters in the Gulf of Mexico region has not been compiled. However, Appendix D provides a synopsis of the available history of the lease sales in the Gulf States as well as in Federal waters. Many activities carried out in State waters prior to the 1950's were not documented or permitted in the way they are now, and information is scarce or lacking (Groat, personal comm., 1984).

The first offshore oil and gas leases were issued in the States of Texas and Louisiana almost 70 years ago. The cumulative number of offshore wells drilled in these State waters as of January 1, 1985, has been significant (i.e., Louisiana--4,223 wells; Texas--1,234 wells) (American Petroleum Institute, 1988). The estimated number of offshore oil and gas structures (platforms and other structures) as of December 31, 1983, is estimated at about 200 for Texas and 800 for Louisiana (USDI, MMS, 1984d). Pipelines that are located entirely within State offshore waters, wetlands, and uplands do not require permits from MMS, and an accurate database for such lines is not readily available.

In Texas State offshore waters, accumulated oil and gas production through October 1989 was 22.2 million bbl of oil and 2,888 billion cubic feet of wet gas (gas that includes condensate). Annual oil production peaked in 1977 at 2.6 million bbl; by 1982 production was down to 1.8 million bbl. However, in 1985 production rose to 2.2 million bbl (Risotto and Collins, 1986). Annual crude oil production was again down to 1.27 million bbl in 1988. Annual gas production peaked in 1980 at 254 billion cubic feet. The production of wet gas in 1988 amounted to 96 billion cubic feet. As of August 31, 1989, there were 363 active leases in Texas State waters, covering approximately 357,894 acres. A total of 9 manned, 104 unmanned, and 98 satellite platforms were in place as of year-end 1988.

In Louisiana State offshore waters, accumulated oil and gas production to January 1, 1988, was 1.442 billion bbl and 10,657 billion cubic feet, respectively. Annual oil production peaked at 72.1 million bbl in 1970 and had declined to 23.7 million bbl in 1985. Annual oil production was 25.2 million bbl in 1987 and 24.6 million bbl in 1988. Annual gas production reached a peak of 604 billion cubic feet in 1972, thereafter steadily declining to 225.6 billion cubic feet in 1987 and to 217.2 billion cubic feet in 1988. For Louisiana, some information is available on leasing since 1960. The Louisiana Mineral Board conducts lease sales monthly. Between January 1962 and October 1987, the State leased 940,249 acres offshore. Between January 1980 and August 1983, the State awarded 235 leases, which totaled 223,740 acres offshore. As of January 1988, there are 237 tracts and 386,830 acres under lease offshore Louisiana.

The State of Mississippi has experienced a limited amount of offshore activity. Three exploratory wells were drilled in the 1950's. All were dry holes, and the relevant leases have expired. In 1982 the State held an offshore offering in which only one lease was granted. As a result of the success experienced in the Mobile Bay area (in Alabama State waters) 16 km (10 mi) to the east of the State line, Mississippi offered the lower portion of Mississippi Sound for lease in January 1985. Several leases were granted as a result of the offering. In FY 86, the State of Mississippi held its third lease sale, which resulted in the leasing of about 20,000 acres. In late August 1986, an exploratory oil and gas well was drilled in Mississippi coastal waters 7 km (4.5 mi) south of Ship Island. Fifteen days after drilling had begun, the drilling was terminated. A depth of 1,805 m (5,921 ft) had been reached, and the drilling officials announced that no oil or gas was discovered. Currently, there are no active leases in Mississippi State waters.

Oil and gas activity in the State of Alabama's offshore waters has become active over the past few years. The Lower Mobile Bay Mary Ann Field was discovered in 1979. Since the initial discovery of 1979, several other discoveries have been made, confirming the commercial potential of natural gas in Mobile Bay. In 1981, 1982, and 1984, the State leased 33 blocks. On February 23, 1988, Alabama held an offshore oil and gas lease sale in State waters. Approximately 90,556 acres were offered and 7 leases were awarded. On July 19, 1988, Alabama held another offshore oil and gas lease sale and 5 leases were awarded. As of January 1989, there were 36 leases in the State offshore waters, covering approximately 111,000 acres. A total of 25 wells have been drilled to date, and exploration activities by a number of companies continue. There are currently two producing fields in Alabama State waters. The Lower Mobile Bay Mary Ann Field has four producing wells from which gas production has reached 14 billion cubic feet as of April 1989. The South East Mobile Bay Field has one producing well and has produced 310,367 million cubic feet of gas as of April 1989. A total of three platforms are currently located in Alabama State waters.

The State of Florida has experienced a limited amount of drilling in State coastal waters. Between 1945 and 1983, 29 exploratory wells were drilled in waters under Florida jurisdiction. These wells were drilled at sites extending along the entire Gulf Coast from Pensacola to the Keys and Dry Tortugas. None of these wells resulted in development or production. Coastal Petroleum Company holds the only two active leases in Florida waters as of January 1989. These leases, which date back to the 1940's, are large in size and geographic coverage. Currently, there is a moratorium on drilling activity in Florida State waters, and the State has no plans for lease sales in the future.

3. Other Major Offshore Activities

a. Ocean Dumping

As discussed in Section I.B.4.o., all ocean dumping is regulated by the Marine Protection, Research, and Sanctuaries Act of 1972. A USEPA permit is required for all ocean dumping of industrial wastes and municipal sludge materials. Ocean dumping of sewage sludge and industrial wastes is no longer permitted. The USEPA has one designated deep-water disposal area in the Gulf of Mexico, as shown on Visual No. 3. This site is designated for the incineration of hazardous wastes, should any such permits be issued in the future; there are no incineration permits active at the present time. The incineration program may be considered inactive at the present time, but the disposal area has not been officially de-designated. Dredged Material Disposal Sites, mostly located in State waters, are used for the disposal of dredged material from the U.S. Army Corps of Engineers channel-dredging programs. See Section IV.B.4.a. for a discussion of the impacts of dredging activities.

b. Deep-water Ports

The Deepwater Port Act of 1974 (33 U.S.C. 1501) gives DOT the authority to license deepwater ports. The purpose of a deepwater port is to provide offshore terminal facilities for offloading oil from tankers too large (typically supertankers with drafts greater than 40 ft and up to 700,000 dwt) for conventional ports and to transport the oil to shore via pipeline, thus avoiding the need for lightering. The Louisiana Offshore Oil Port (LOOP) is the only deepwater port in the Gulf. It is located in 35 m (115 ft) of water in Grand Isle Block 59, approximately 30 km (19 mi) from shore. Vessel access to LOOP is by means of the designated fairway and safety zone (Visual No. 1). No mobile drilling operations or installation of permanent structures may take place in these areas. An anchorage area is also designated in the vicinity of LOOP. Fixed and mobile structures may be placed in anchorages under certain spacing limitations. Fairways associated with LOOP are designated in 33 CFR 166 (Shipping Safety Fairways). This information was published in the *Federal Register* on July 1, 1985 (50 FR 28989).

The Deepwater Port Liability Fund (33 U.S.C. 1517), established by the Deepwater Port Act of 1974, covers the operations of LOOP. Liability (increased by the 1984 amendments to the Act) is covered by a $4 million liability fund for oil-pollution damages. Liability is imposed without regard to fault and includes both cleanup costs and damages. Liability of a vessel owner and operator associated with deepwater port oil spills is limited to $150 per gross tonnage for the vessel or $20 million, whichever is less. Liability of the deepwater port facility is limited to $50 million. The Act extends only to an oil discharge from a vessel within a deepwater port and the port's navigational safety zone.

In 1987, LOOP offloaded 218,427,000 bbl of crude oil from tankers, 47 million bbl of which were domestic Alaskan crude.

c. Nonenergy Minerals Program in the Gulf of Mexico

At the present time, there is sulphur produced from leases in Federal waters in the Gulf of Mexico. This information is presented in Section IV.B.3.g.

On December 31, 1986, Secretary of the Interior Donald P. Hodel and the Governors of Alabama, Mississippi, Louisiana, and Texas announced an agreement to establish a joint Federal/State task force to study the occurrence, location, and economic-feasibility of developing marine mineral resources offshore those states. The Task Force is jointly co-chaired by representatives from the Alabama Geological Survey, the Mississippi Mineral Resources Institute (MMRI), the Louisiana Geological Survey, the Texas Bureau of Economic Geology, and MMS.

The Task Force has spent the past year developing an inventory of the publicly available geologic and geophysical data, identifying mineral commodities and the particular areas of potential commercial interest, and performing a preliminary economic-feasibility study. A draft report was completed in November 1988, and a final report with recommendations for further action was submitted to the Secretary of the Interior and the Governors in March 1989. This report summarized the work of the Task Force, projected future work to be undertaken, and made recommendations on the engineering, environmental, and economic feasibility of mineral extraction on the OCS. The Task Force currently is studying OCS sources of beach nourishment materials around ship shoals.

Additional information regarding nonenergy minerals production on the Gulf of Mexico can be found at 53 FR 25242, 54 FR 2041, and 54 FR 2057.

d. Marine Transportation

Vessels operating offshore often use the network of established safety fairways as shown on Visuals Nos. 3 and 3E. Over the years, an extensive shipping pattern has developed among the major Gulf ports and between the ports and destinations outside the northern Gulf via the Straits of Florida, the Yucatan Channel, and the Bay of Campeche. As oil and gas development began to move offshore, the potential for conflicts between marine transportation and oil and gas activities increased.

Marine transportation is not projected to increase in future years, but it has fluctuated from year to year. Marine-transportation traffic can contribute to operational errors, which might result in groundings or in collisions involving other vessels or fixed structures such as platforms and rigs. This may lead to losses in lives, property, and possibly environmental damage if hazardous cargo is involved.

Records of vessel mishaps concerned with OCS operations show that 85 vessel mishaps occurred between 1960 and 1986, a 26-year period. Of these 85 events, 10 were noncontact events, that is, the vessel did not come into contact with an OCS structure or another vessel. Of the remaining 75 vessel mishaps, 46 (61%) resulted in minor property damage and 29 (39%) resulted in major property damage. Most of the vessel mishaps are the result of a service vessel (crewboat) bumping into the superstructure of a platform.

Based on the descriptions in the Events File, 77 percent (58 vessel mishaps) were OCS vessels and 23 percent (17 mishaps) were non-OCS vessels. The numbers are as follows:

Vessel Mishap with Structure Contact	Number	Total(%)
OCS Vessel Contacts		
Minor Damage	41	55
Major Damage	17	22
Subtotal	58	77
Non-OCS Vessel Contacts		
Minor Damage	05	07
Major Damage	12	16
Subtotal	17	23
Total	75	100

The 26-year record shows that an annual average of 1.5 vessel mishaps that occur involve major property damage resulting from both OCS and non-OCS events Gulfwide. When OCS events are examined, less than one mishap (0.8%) occurs per year. Non-OCS events average about one vessel mishap every other year. Five accidents involving fatalities have occurred. Three of the five accidents were noncontact events, one involved no property damage, and the fifth (included in the figures above) resulted in major property damage.

The key mitigation factor for this problem was the establishment of a series of safety fairways and anchorages to provide unobstructed approach for vessels using U.S. ports (Section IV.B.4.a.). Fairways play an important role in the avoidance of collisions on the OCS, particularly in the case of the larger ocean-going vessels, but not all vessels can stay within the fairways. Many vessels, such as fishing boats and vessels supporting offshore oil and gas operations, travel through areas with high concentrations of fixed structures. In such cases, the most important mitigation factor is the requirement for adequate marking and lighting of structures. After a structure has been in place for a while, it often becomes a landmark and an aid to navigation for vessels that operate in the area on a regular basis.

There is a substantial amount of domestic waterborne commerce along the Gulf Coast that does not always use open Gulf waters. Vessels engaged in this activity generally use the Gulf Intracoastal Waterway (GIWW), which follows the coastline inshore and through bays and estuaries, and in some cases offshore from Fort Myers, Florida, to Brownsville, Texas (Visuals Nos. 1 and 1E).

The most significant contributions of marine transportation to cumulative impacts in the Gulf are from the tankering of imported crude oil. Extensive refinery capacity, easy port access, and a well-developed, onshore-transportation system have contributed to the development of the Gulf Coast region as an important center for handling imported oil and production from other domestic sources such as Alaska and California (henceforth included in the category of imports). The area also includes the Nation's Strategic Petroleum Reserve and LOOP, the only deep-water crude-oil terminal in the country (Section IV.B.3.b.).

e. Military Activities

The air space over the Gulf of Mexico is used extensively by DOD for conducting various air-to-air and air-to-surface mission operations. A series of nine military warning areas and five water test areas are located within the Gulf. These warning and water test areas are multiple-use areas, wherein military operations and oil and gas development have coexisted without conflict for many years. For the locations of these military warning areas, see Visuals Nos. 3 and 3E.

Utilization of offshore areas by DOD is provided for in 32 CFR 252. The DOD policy of joint usage and coordination with DOI to ensure compatibility between agencies' programs is expressed within this regulation.

Military warning areas are established through the Federal Aviation Administration Handbook 7400.2B, Part 5, Chapter 15, which sets aside an air space area by the Federal Aviation Administration for use by the military. The military is not given a first use or a priority use of any area. The areas of military use are set aside so that Federal Aviation Administration can direct air traffic over or around them. The Federal Aviation Administration Handbook also refers to an Executive Order that calls for coordination among the Departments of Transportation, State, and Defense on the establishment and use of warning areas in international waters (international waters are considered by the Federal Aviation Administration as anything beyond the State/Federal boundaries). By the mechanisms through which the military warning areas are established and maintained, DOD or any other agency cannot restrict the use of a warning area. Also, the mechanisms for the establishment of a warning area do not provide any means for the area's enforcement. For all warning areas, the using agency, boundaries, and times of use are published by the Defense Mapping Agency in the semiannual Department of Defense Flight Information Publication, Special Use Airspace, North and South America.

The Eglin Water Test Areas were established by a letter of agreement among the Jacksonville Armament Research and Test Center (ARTC), Houston ARTC, Miami ARTC, and Eglin Armament Division on April 26, 1971.

Central Gulf of Mexico

The Central Gulf has three warning areas that are used for military operations. They total approximately 4 million acres, or 7.6 percent, of the water and air space of the sale area. The portions of the Eglin Water Test Areas comprise another 4 million acres, or 7.3 percent, of the Central Gulf.

Warning Areas	Defense Operations Conducted
W-92	Air-to-air gunnery, rocket firing, sonar buoy operations
W-453	Air National Guard training
W-155	Carrier operations, carrier pilot training
EWTA-1	Rocket and missile testing and research
EWTA-2	Rocket and missile testing and research

Western Gulf of Mexico

The Western Gulf has two warning areas used for DOD operations. They total approximately 12 million acres, or 33 percent, of the water and air space of the sale area.

Warning Areas	Defense Operations Conducted
W-228	Carrier operations, air-to-air gunnery, rocket firing, aircraft operations, submarine operations
W-602	High-altitude training

Eastern Gulf of Mexico

The Eastern Gulf of Mexico has five warning areas for various military operations. They total approximately 32 million acres, or 55 percent, of the water and air space of the sale area.

Warning Areas	Defense Operations Conducted
W-155	Carrier operations, air and surface gunnery, minesweeping
W-151	Surface and subsurface operations
W-174	Carrier operations, air-to-air gunnery, air combat maneuvers, high-altitude fighter radar intercept, aerobatic training, instrument training
W-470	Air-to-air and air-to-surface operations, rocket firing, missile testing and research
W-168	Air-to-air and air-to-surface operations, rocket firing, missile testing and research

The five water test areas of the Eastern Gulf cover an additional 40 percent of the sale area. They have an official warning area status and, thus, there are restrictions on oil and gas development within these areas.

The DOI has recognized a high-priority DOD-use area in the Eastern Gulf within the water test areas and warning areas 155, 151, and 470. Also, DOD has expressed concern over the possibility of increased oil and gas activity in W-174.

f. Commercial Fishing

In 1988, the Gulf of Mexico yielded the nation's largest regional commercial fishery by weight. The Gulf fisheries landings were 27 percent of the national total by weight and 20 percent by value. Most commercial species harvested from Federal waters of the Gulf of Mexico are considered to be at or near an overfished condition. Continued fishing at the present levels may result in rapid declines in commercial landings and eventual failure of certain fisheries. Commercial landings of traditional fisheries, such as shrimp, red snapper, and spiny lobster, have declined over the past decade despite substantial increases in fishing effort. Commercial landings of recent fisheries--such as shark, black drum, and tuna--have increased exponentially over the past 5 years, and these fisheries are thought to be in danger of collapse (Angelovic, written comm., 1989; USDC, NMFS, 1989a).

Nearly all species significantly contributing to the Gulf of Mexico's commercial catches are estuarine dependent. The degradation of inshore water quality and loss of Gulf wetlands as nursery areas are considered significant threats to commercial fishing (Angelovic, written comm., 1989; Christmas et al., 1988; Gulf States Marine Fisheries Commission, 1988). In addition, conflicts between fishermen using fixed gear (traps) and mobile gear (trawls) continue to be a problem in some parts of the Gulf (Federal Fisheries News Bulletin, 1989a and b).

Fishery Management Plans (FMP's) are developed by the Gulf of Mexico Fishery Management Council (GMFMC) to assess and manage commercial species of fish that are harvested from Federal waters and in need of conservation. Since 1981, eight FMP's have been implemented for the following species in the Gulf of Mexico: shrimp, stone crab, spiny lobster, coastal pelagics, coral, reef fish, swordfish, and red drum. The GMFMC has initiated development of additional management plans for butterfish, shark, and black drum (Gulf of Mexico Fishery Management Council, 1989; Horst, 1989).

The Gulf of Mexico shrimp fishery is the most valuable in the United States, accounting for 80 percent of the total domestic production (USDC, NMFS, 1989a). Three species of shrimp--brown, white, and pink--dominate the landings. The status of the stocks are as follows: (1) brown shrimp yields are at or near the maximum sustainable levels; (2) white shrimp yields are beyond maximum sustainable levels with signs of overfishing occurring; and (3) pink shrimp yields are at or beyond maximum sustainable levels.

The shrimp fishery is facing a number of additional problems: too many vessels are given available yields of shrimp; imports of less expensive shrimp from foreign countries accounting for 77.5 percent of domestic consumption; a 10 percent decline in ex-vessel price of domestic shrimp over the past 5 years; increases in interest rates to finance acquisition of equipment, vessels, and other related fishing needs; increases in fuel prices; excessive costs of marine casualty insurance; requiring the use of turtle excluder devices; excessive bycatches of finfish; and conflicts with other targeted fisheries (Angelovic, written comm., 1989; Gulf States Marine Fisheries Commission, 1988). It has been estimated that for every pound of shrimp landed, over nine pounds of valuable finfish are killed and discarded as bycatch (Sport Fishing Institute, 1989a). In an attempt to lessen anticipated conflicts between commercial fishing for shrimp, spiny lobster, and stone crab, the GMFMC has closed areas in the Eastern Gulf to shrimp trawling during the traditional trap-fishing seasons for lobster and stone crab.

The red drum fishery was closed to all harvest in Federal waters of the Gulf of Mexico on January 1, 1988. Stock assessment concluded that red drum were heavily fished prior to moving offshore to spawn and that those fish less than 12 years of age were poorly represented in the offshore spawning population. Continued harvest of adults from Federal waters would further reduce spawning stock and increase the risk of a collapse of the red drum fishery (USDC, NMFS, 1989a).

Red snapper resources in the Gulf of Mexico are believed to be severely overfished from both directed and bycatch fisheries. In terms of value and historical landings, red snapper is the most important species in the reeffish complex managed under a FMP. The species is presently considered to be in worse condition than was red drum when that fishery was closed in 1988 to all further harvest in Federal waters.

The major concern of the stone crab fishery is whether harvest has reached or exceeded maximum-sustainable yield. Until recently, the fishery has been expanding in terms of increasing catch within traditional fishing areas and previously unfished or underfished regions. However, the total harvest has declined steadily over the past several years. The GMFMC is considering limitations on the number of fishermen and traps in the stone crab fishery.

Spiny lobster fishing is practiced exclusively in the Eastern Gulf of Mexico. It is believed that the stock is showing signs of growth overfishing. Fishing mortality is high due to the number of undersized lobsters used to bait lobster fishing traps and the number of traps in the fishery that far exceed the number required to harvest the present yield. Fishermen contend that the present fishery practices are the most optimal for their objectives. The GMFMC is considering limitations on the number of fishermen and traps in the spiny lobster fishery.

The coastal pelagic FMP addresses a number of species. Two of the more important species are king and Spanish mackerel. Both species have been extensively overfished and are now under a managed rebuilding program. Since the early 1980's, there has been a marked absence of a strong year-class of king mackerel. Spawning-stock biomass has exhibited some gains, and recruitment is stable at low levels. There is concern over the possible need for two management units for king mackerel within the Gulf of Mexico with the impact of the increasing Mexican fishery. Spanish mackerel stocks are showing positive signs of recovery. Spawning-stock biomass and recruitment appear to be increasing. Most of the Spanish mackerel catch is taken off Florida. Capture of 50-80 percent of the yearly commercial allocation within a period of 3 weeks by southeast Florida fishermen has raised questions of conflict with recreational fishermen, who believe their allocation should be increased.

Commercial landings of swordfish have increased steadily over the past several years, with serious implications for the future. The percentage of older fish and spawning biomass has declined significantly. The GMFMC is developing a number of alternatives to better manage this resource.

Blue marlin and white marlin are believed to be at or near the point of full exploitation. There is concern about the increasing mortality of marlin as bycatch associated with the escalating yellowfin tuna longline fishery (Sport Fishing Institute, 1989b). The tuna fishing industry has expanded at an alarming rate in the Gulf of Mexico over the past five years. Tuna are now included under the Magnuson Fishery Conservation and Management Act of 1976 (MFCMA), and the GMFMC can begin to manage the tuna fishing industry and address the marlin bycatch issue. For more information concerning the MFCMA, see Section I.B.4.g.

The taking of stony corals or gorgonian sea fans is prohibited. Fishing for soft coral octocorals is presently below the limits of maximum yield. There are significant concerns about the butterfish fishery in that butterfish trawlers allegedly destroy coral-reef habitat and take a large number of snappers and groupers as bycatch. In addition, a newly formed fishery of "live rock" for the ornamental trade is receiving attention due to the allegation that "live rock" fishing may purposefully or inadvertently include the harvest of stony coral.

The present concern about the condition of the black drum fishery stems directly from the closure of the red drum fishery. Almost immediately after closure black drum were accepted as a substitute for red drum within the commercial market. The intensive fishing effort for red drum was switched to black drum without need to change fishing gear or technique. As a result, stocks of black drum are believed to be fast approaching a seriously depleted condition. Several Gulf States have instituted interim management measures in State waters to reduce black drum catches while an FMP is developed and implemented (Horst, 1989).

A strong market for shark has resulted in soaring catches over the past several years. Shark stocks are unable to sustain the present heavy fishing pressure; without management, the fishery is expected to collapse within the near future. The GMFMC has requested that Gulf States consider interim management measures while an FMP is developed and implemented (Gulf Fishery News, 1989).

g. Sulphur Operations

The sulphur industry has been well established along the Louisiana and Texas Gulf coast since the 1920's. The Frasch-mining process was developed to mine sulphur from the cap rock of salt domes in the area.

Three offshore mines, operated by Freeport McMoran, are in existence off Jefferson Parish, Louisiana. In support of the offshore mines, Freeport McMoran operates an onshore support base located on the eastern end of Grand Isle, Louisiana. Production from the Grand Isle Mine is pipelined to the Grand Isle facility, where it is transferred to insulated barges for transportation to the shipping and processing terminal at Port Sulphur, Louisiana. Much of Freeport's sulphur is shipped up the Mississippi River to processing facilities in Louisiana or to Tampa, Florida, for use in the fertilizer industry.

Geology (and the Formation of Cap Rock Sulphur)

The entire northern Gulf of Mexico coastal region is underlain by a thick sequence of evaporites, principally salt, known as the Louann Salt. Deep-well data from south Arkansas, northeast Texas, and north Louisiana revealed stratigraphic relationships of overlying Upper Jurassic rocks, which led Hazzard et al. (1947) to the conclusion that the Louann Salt was of Permian age. Although the exact age of the Louann Salt is still uncertain, subsequent works by Halbouty and Hardin (1956), Humphrey (1956), Mixon et al. (1959), and Murray (1961) indicate that the age is probably Upper Triassic-Lower Jurassic.

Following deposition of the Louann Salt, the thick sequence of evaporites has been buried under thousands of feet of sediments. Under the pressure created by the great weight of overburden, the salt became plastic in nature and began to flow. Parker and McDowell (1951, 1955) found that salt flow can be initiated by pressure differentials when sediment thicknesses are 305 m (1,000 ft) greater in one area than another, and Trusheim showed that in the German Zechstein basins an overburden of 1,000 m (3,281 ft) and a thickness of at least 300 m (984 ft) of salt were necessary to initiate flowage. Because its density was less than the overlying sediment, the salt found weaknesses in the sediment and forced its way upward to form diapirs. Halbouty (1979) published one of the most comprehensive collections of information on salt domes and their formation available.

As the salt mass forces its way up through the overlying sediment, it encounters a circulating water table. The evaporite mineral, anhydrite, is residual and was originally present in the salt. Being less soluble than salt, the anhydrite remains behind as the salt near the top or sides of the diapir dissolves. This residual anhydrite collects at the top of the dome to form cap rock. The cap rock grows from the top down; that is, anhydrite is added to the bottom of the cap as the salt is dissolved away. According to Feely and Kulp (1959) the thickness of the cap rock at any time depends upon the rate of movement of the salt, the rate of the flow of water across the salt, and the anhydrite content of the salt. Another theory is that the anhydrite caps may be exotic blocks of a subsalt surface that were carried up with the salt.

At some point in its upward movement, the salt mass encounters hydrocarbon-bearing formations; and petroleum is introduced to the cap rock. It is believed that the bacteria, Desulfovibrio desulfricans, causes a process of sulphate reduction on the anhydrite (calcium sulphate). Hydrogen sulfide gas (H_2S) is generated as one byproduct of sulphate reduction. To prevent the flushing of H_2S, a sealing mechanism, known as false cap rock, must be present. False cap rock generally consists of impervious clays or shales overlying the cap rock. Some elemental sulphur may be formed directly by the reduction of sulphate. Much of the elemental sulphur is formed by the oxidation of hydrogen sulfide.

Other byproducts from the reduction of sulphate in the anhydrite are calcite (calcium carbonate) and gypsum (hydrated calcium sulphate). Thus, those cap rocks that contain elemental sulphur consist of three parts: (1) the basal anhydrite; (2) a transition zone containing gypsum, calcite, sulphur, and some accessory minerals; and (3) an overlying calcite zone. Not all salt domes have cap rocks, nor do all cap rocks contain elemental sulphur.

From the above discussion, it can be seen that a critical sequence of events must take place in order to form elemental sulphur in sufficient quantities for commercial mining. First, the moving salt must encounter a circulating water table. Next, the salt must be dissolved to form a residual cap rock of anhydrite. The cap rock must then encounter hydrocarbon zones in order to be exposed to the sulphate-reducing bacteria. Then, there must be an impervious barrier to trap the H_2S formed by sulphate reduction. And finally, the H_2S must be oxidized to form elemental sulphur.

Studies throughout the Gulf Coast area of Texas and Louisiana have indicated that deposits of sulphur worthy of development have been found in a very small percentage of domes, and at depths generally not greater than 762 m (approximately 2,500 ft). Domes encountered at depths below 1,500 m (approximately 5,000 ft) have little or no cap rock, ruling them out as possible sulphur sites.

The only quantitative method of determining the occurrence, distribution, and thickness of sulphur in cap rock is coring. Seismic methods can identify the presence of salt domes, but they cannot reliably indicate the presence of cap rock. Domes having cap rock can be inferred by using gravity data, but the presence of sulphur can be determined only by drilling.

Geologic Hazards

Within the Central Gulf of Mexico, major geohazards to offshore development are associated with those seafloor geologic features that result in seafloor instability. Primarily, the hazards are produced by (1) increased gradient at the edge of the continental shelf where it merges with the continental slope; (2) regional high rates of deposition on the continental shelf that cause isostatic adjustments and deep-seated gravity faulting; (3) local high rates of unconsolidated sediments deposited on the increased gradient of the contintental shelf edge that has led to intensive slumping and mudslides (particularly in the area of the Mississippi River Delta); (4) diapiric movement of low-density material through overlying sediment that has caused extensive deformation, the damming of sediments, gravity faulting, and slumping; and (5) high biogenic gas content in rapidly deposited sediment. Since sulphur operations are by definition associated with diapirs, the hazards associated with diapirs would be most threatening to such activity. In addition to the faulting and deformation around diapirs, there is also the possibility of encountering shallow, high-pressure gas- or oil-bearing formations.

Grand Isle Mine

Sulphur was discovered in 1946 by Humble Oil Company while drilling for oil around a salt dome occurring beneath Grand Isle Area Blocks 9, 10, 18, and 19. Freeport Sulphur Company was assigned the sulphur rights in 1956 and constructed the Grand Isle Mine. The mine, completed and put into production in 1960, stands in 15 m (50 ft) of water some 12 km (7 mi) out in the Gulf and was the first offshore sulphur mine in the world. The sulphur-bearing zone varies from 67-130 m (220-425 ft) thick and occurs some 550-610 m (1,800-2,000 ft) below the seafloor. The mine was originally in Federal waters but reverted to the State of Louisiana under a Supreme Court Supplemental Decree of 1975.

The Grand Isle Mine consists of 5 large platforms and 10 smaller ones connected by nearly a mile and a half of bridges, making it the largest single offshore structure in the Western Hemisphere. The mine has a large power plant platform with shop facilities, a crew quarters/office platform, two conventional production platforms, one submersible production platform, and a bleedwater/brinewell platform.

To date, 10 test wells, 437 sulphur wells, 35 bleedwater wells, and 3 brine wells have been drilled at the Grand Isle Mine, with 97 more sulphur wells to be drilled in the future. Many of the wells are highly directional, some being deflected up to 75 degrees from vertical. Freeport drillers are able to complete the highly directional wells within an 8-m (25-ft) target at total depth. Some 20-25 wells are in production at any one time. The average well life for a sulphur well is around 15 months, and 95 percent of the well failures are due to corrosion.

Salt is solution-mined, and the brine is used as a mining fluid at the Grand Isle Mine. The higher salinity brine increases the density of the mining fluid and helps keep the heat down in the formation for improved heat distribution.

Sulphur from the wells flows into flash pans on the production platforms, where the air-lift air is vented and any moisture associated with the sulphur is flashed off. Very minor amounts of H_2S and SO_2 are vented to the atmosphere from the flash pans. The molten sulphur then flows to a central pipeline where it is piped to shore on the east end of Grand Isle, Louisiana. From the shorebase on Grand Isle, the sulphur is transferred to the Port Sulphur terminal by barge.

The 12-km (7-mi) sulphur pipeline consists of three concentric pipes with two others strapped to the sides to form a bundle. A 14-in protective casing contains an insulated 7 5/8-in hot-water jacket, which contains a 6-in sulphur line. The hot-water jacket is mounted on rollers within the protective casing to allow movement caused by thermal expansion. Strapped to the outside of the protective casing are a 6 5/8-in freshwater line to the mine and a 4 1/2-in hot-water return line. Prior to any shutdown (i.e., evacuation for hurricanes, etc.), the entire system of flowlines, wells, and the pipeline to shore must be flushed of all sulphur in order to keep them from solidifying.

Freshwater piped from shore is used mostly for freshwater drilling muds. The Grand Isle Mine also uses two desalination plants--an osmosis type and a vacuum type. The plants normally operate at around 750 gallons per minute, and much of the water is used for the boilers and heat exchangers.

Depending on demand and sales, the Grand Isle Mine has averaged around 700,000 tons of sulphur production per year. It is estimated that enough sulphur remains to keep the mine in production for another 5-6 years.

Caminada Mine

The Caminada Mine, also owned by Freeport Sulphur Company, lies in Grand Isle Area Blocks 16, 17, 22, and 23, some 9.5 km (5.5 mi) west-southwest of the Grand Isle Mine. The mine is located in Federal waters. The sulphur-bearing zone is not as thick as the Grand Isle Mine, but it is larger in areal extent and is located approximately 535 m (1,750 ft) below the seafloor.

Production was first initiated on March 25, 1969, and a total of 90 sulphur wells, 7 bleedwater wells, and 1 brine well have been drilled to date. One year after production was first initiated, there was a suspension of production due to a drop in the price of sulphur and loss of the sulphur pipeline to shore. The mine was in caretaking status until late 1986, when plans to reactivate the mine were approved by MMS.

Mining procedures are the same as those used at the Grand Isle Mine. All sulphur produced is to be transported to the Grand Isle shorebase by seagoing sulphur barges. It is anticipated that two barge trips per day will be required and, based on 20 years of meteorological and oceanographic data collected at the mine, anticipated weather downtime may be only 5 percent.

The Caminada Mine consists of a power-plant platform, a shop/warehouse platform, a living quarters/office platform, two production platforms, and a bleedwater/brine-well platform. Production at the Caminada Mine is projected to continue until around 1999.

Sources: Davis and Detro, 1984; USDI, MMS, 1986a; Freeport Sulphur Company, 1978; Mickleberry, personal comm., 1986.

Main Pass Sulphur Mine

Main Pass Sulphur Mine, owned by Freeport-McMoran and partners, lies in Main Pass Area Block 299, approximately 25 km (15 mi) from shore in 65 m (215 ft) of water. Drilling at Main Pass began in December 1988, with sulphur encountered in 19 of the 20 wells drilled. The sulphur deposit exists in a limestone cap rock situated over a salt dome structure. The greatest thickness of the sulphur horizon is in the southeast part of the dome. The sulphur horizon is abruptly pinched out in the southeast part of the dome, while a more gradual thinning occurs in the western region. The commercial sulphur horizon varies in thickness from 5 to 70 m (16 to 230 ft) and occurs from 458 to 560 m subsea (1,503 to 1,841 ft).

The Frasch technique is used for the mining of sulphur. Heated seawater, injected into the mineral-bearing formation, results in melting of the elemental sulphur. Air, pumped to the level of the molten sulphur, lifts the sulphur to the surface. A steam-heated generator discharges air and other gases in the sulphur to the atmosphere. Sulphur is subsequently collected in vessels known as "pans," where it is pumped to storage tanks and then to barges. The sulphur is ultimately transported to Port Sulphur.

Five onshore facilities will support the mine. The New Orleans office of Freeport-McMoran contains the operations and mining staff that will commute to and from the mine. New Orleans Lakefront Aviation houses the company's amphibious airplane needed to transport personnel to the Venice base. The Harvey terminal is Freeport-McMoran's receiving and shipping center of material from the mine, and the Venice base is used to transport materials and men to the mine. Two Bell 412 helicopters and one Bell 206L1 helicopter will be used for crew changes. Two crewboats will be used during inclement weather. Transportation and shipments of sulphur from the mine are handled by the Port Sulphur terminal.

Ten production platforms are expected for all drilling activities, with production of sulphur expected to begin January 1992. Recoverable reserves of 67 million long tons (MMLT) are anticipated so the Main Pass Sulphur Mine should produce for 30 years or more. Plans are for 1,000-1,500 wells to be drilled in the future, with production expected to be 2 MMLT of sulphur per year; and additionally for approximately 30 wells to be on production simultaneously throughout the life of the mine.

Source: Becnel, personal comm., 1989.

h. Import Tankering

The most significant contributions of marine transportation to cumulative impacts in the Gulf are from the tankering of imported crude oil into the Gulf. Extensive refinery capacity, easy port access, and a well-developed onshore transportation system have contributed to the development of the Gulf Coast region as an important center for handling imported oil and production from other domestic sources such as Alaska and California (henceforth included in the category of imports). The area also includes the Nation's Strategic Petroleum Reserve and LOOP, the only deep-water crude-oil terminal in the country (Section IV.B.3.b.).

The major Gulf Coast ports of entry for imported oil are listed in Table IV-11. Included are the amounts of crude oil estimated to be imported into each Gulf port during the 39-year life of the proposed action (1991-2029). The total amount of expected imported crude oil during this period is 103.67 billion bbl. (This figure is extrapolated from Department of Energy estimates.) The Gulf receives oil from almost all exporting countries, the majority of which is received from OPEC countries. Of the oil imported into the Gulf, 70 percent is projected to enter through the Yucatan Channel; only 12 percent is projected to enter through the Straits of Florida. Due to the LOOP current, tanker movement is preferentially routed through the Yucatan Channel. Tanker captains use the circulation patterns in the Straits of Florida to aid in returning to their ports of origin. Oil from Mexico primarily enters the Gulf from the Bay of Campeche; 18 percent is of imported oil comes in from the Bay of Campeche.

Crude-oil tankering routinely contributes to contamination of the marine environment in two ways: (1) Operational discharges occur when oily bilge water is pumped overboard and during tank cleaning and ballasting. Tankers' bilges must be periodically pumped out to remove oil and water collected in the lower part of the ship's hull from leaking pipes, valves, and machinery. Bilge water may first be put into a settling tank to separate the oil from the water. Some vessels pump bilge water through an oil-water separator, which can significantly reduce the amount of oil discharged. (2) Oil is usually discharged during tank cleaning because some oil inevitably remains in the tanks after offloading. Also, ships that do not have segregated ballast tanks take on seawater into "empty" oil tanks for use as ballast. When discharged, this water will contain the oil residue left in the tank. United States and international regulations generally prohibit any operational discharges within 80 km (50 mi) of land and require that no more than 15.8 gallons (60 liters) of oil be discharged per nautical mile. In addition, no vessel may discharge more than 1/15,000 of its dwt.

Accidental spills normally result from collisions and groundings. In 1988, about 6 percent of the tanker fleet was involved in collisions or groundings (Kasoulides, 1988). Approximately 92 percent of all spills occur in port (Oil Spill Intelligence Report, 1982). Since 1974, there have been 30 spills of either crude oil or refined products greater than 1,000 bbl that have occurred in the Gulf area (Anderson, personal comm., 1989), 13 of these being crude oil. The OSRA model estimates that there will be 47 large spills (1,000 bbl or greater) occurring in Gulf OCS waters, as well as 21 large spills at the ports listed above, from tankering of crude-oil imports during the sale life. The potential impacts of oil spills from crude-oil import tankering and other sources are considered in the cumulative analyses.

4. Other Major Coastal/Onshore Activities

a. Dredging

Dredging operations for channel construction and maintenance, pipeline emplacement, access to support facilities, creation of harbor and docking areas, and siting for onshore facilities in coastal areas have environmental effects that range from transitory to long term. In general, dredging operations result in short-term, localized, moderately severe impacts. Dredging activities release sediments into the water column that result in transient increased turbidity in the surrounding waters. This turbidity leads to reduced light penetration and possible clogging of the filtering systems of benthic organisms. Coral, filter feeders such as oysters, and barnacles are particularly vulnerable to the effects of siltation resulting from dredging. Dredged materials may contain chemical contaminants that can include toxic organics, heavy metals, high levels of nutrients, and hydrocarbon compounds that can affect flora and fauna contacted by the turbidity plume. Removal of the sediments alters the benthic interface between water and water bottom and may remove substantial burrowing and sessile bottom organisms. Dredged channel topography may result in saltwater

Table IV-11

Projected Crude-Oil Imports: Volume of Crude Oil Transported and Offloaded at Gulf of Mexico Ports During the Cumulative Analysis Period, 1991-2029

Port	Volume Transported/Offloaded (billion bbl)
Mobile, Ala.	1.04
Pascagoula, Miss.	10.37
Miss. River Ports	10.37
LOOP	15.55
Lake Charles, La.	10.37
Port Arthur, La./ Beaumont, Tex.	12.44
Houston/Galveston/ /Texas City, Tex.	26.95
Freeport, Tex.	4.15
Corpus Christi, Tex.	12.44
Total	103.68

Estimates include domestic production transported from Alaska and California via tanker to Gulf of Mexico ports.

Source: USDI, Minerals Management Service, Gulf of Mexico OCS Region estimates, 1989.

intrusion into less saline marsh; movement of chemicals into previously uncontaminated areas; altered tidal exchange, mixing, and circulation; or accelerated drainage processes. The dredged area may create an environment highly susceptible to recurrent low dissolved-oxygen levels or may create a deep-water area that either exposes or collects contaminants or provides refuge for fish.

The deposition of the dredged material on surrounding spoil banks can affect the environment by spoil bank interference with circulation in marsh areas; reduction of nutrient outflow from marshes and swamps; redistribution of nutrients, organic contaminants, and heavy metals possibly contained in spoils; coverage of plants, eggs, larvae, and larger organisms (covering high biomass substrates with low biomass substrates); and deposition of unconsolidated sediments incapable of supporting benthic organisms.

Estimates given in a 1988 MMS study that examined the causes of wetland loss showed that dredged canals and their associated spoils accounted for losses of between 87,450 and 169,641 ha of wetlands during the period 1955-1978 in Louisiana (Turner and Cahoon, 1987). This represented between 30 percent and 59 percent of the wetland-loss problem in Louisiana. Of this, dredge and spoil operations in support of OCS activities accounted for 8-17 percent of the total loss. Loss figures include both direct landloss from dredging and spoil placement and indirect land losses, such as loss caused by subsequent hydrologic changes. The report cautions, however, that these numbers are based on the interpretation of limited data and should be used with caution to indicate only the relative magnitudes of possible impacts.

b. Mississippi River Flood Control

In recent decades, alterations in the hydrology of the Mississippi River basin have caused declines in sedimentation rates and have contributed to marsh deterioration in the coastal wetlands of Louisiana. Coastal marshes appear to expand or diminish in areal extent according to the amount of sediment available, and sedimentation can be a limiting factor controlling marsh growth. In a natural system, overbank flooding is a mechanism of introducing sediment-laden waters into adjoining wetlands. Flood-control levees on the lower Mississippi River and its distributaries have contributed to wetlands loss in the Gulf because levees eliminate overbank flooding and prevent the distribution of alluvial sediments across the Mississippi River Delta.

c. Submergence of Wetlands

The submergence of coastal wetlands in the Gulf of Mexico region contributes to a loss of 13,000 ha/yr in coastal Louisiana. If submergence occurs faster than the rate at which sedimentation and peat formation can build the marsh surface upward, marsh survival is threatened by the waterlogging and ultimate flooding of the marsh. The submergence rate that is critical for the survival of wetlands in different parts of the Gulf has not been determined.

Submergence in the Gulf is occurring most rapidly along the coast of Louisiana. The submergence rate in Louisiana has two components: the rate of eustatic sea level rise and the rate at which the land itself is subsiding beneath the sea. During this century, the eustatic rate of rise of sea level along the Louisiana coast has been relatively constant at 2.3 mm/yr (23 cm/century), although the rate has varied from a sea-level decrease of 3 mm/yr to a maximum increase of 10 mm/yr over decade-long periods (Turner and Cahoon, 1987). Depending on local geologic conditions, the subsidence rate varies across coastal Louisiana from 3 to 10 mm/yr. The primary natural processes responsible for land subsidence include geosynclinal downwarping, compaction, dewatering, and the horizontal flow of recent sediments. Anthropogenic factors, such as fluid withdrawals from oil and gas reservoirs, appear to have only a localized influence on subsidence directly above the reservoirs. In coastal Louisiana, the total area of wetlands with a subsidence potential related to fluid withdrawals greater than 10 cm is about 400 km^2 (Turner and Cahoon, 1987).

Submergence of wetlands is also considered a factor in erosion of wetlands in the WPA (White et al., 1985). In addition to submergence associated with eustatic sea-level rise, submergence along the Texas coast has been compounded in some areas by human-induced land subsidence from groundwater withdrawals (Ratzlaff, 1980) and natural compactional subsidence (Swanson and Thurlow, 1973).

d. Contributors to Coastal Water Quality Problems

The OCS oil leasing program adds only a minor amount to the contaminants already altering coastal waters. Contaminants can be natural components of the marine environment--such as trace metals--that affect the use of the water body only when they exceed a certain level. Others, such as synthetic organics, are antropogenic inputs whose presence alone is considered contamination because they serve no purpose in the natural mechanisms of the ecological components. Parameters usually measured to determine water quality degradation include salinity, biochemical oxygen demand (BOD), chemical oxygen demand, petroleum hydrocarbons (oil and grease), total suspended solids, total dissolved solids, nutrient loadings, heavy and trace metal concentrations, coliform bacteria, synthetic organics, tributyltins from marine paints, toxic substances and hazardous wastes, radionuclides, toxins, and solid wastes (trash). Section III.A.6. provides a description of each of these pollutants affecting Gulf coastal waters.

Major point and nonpoint sources of contaminants occurring along the Gulf Coast include the petrochemical industry; hazardous waste sites and disposal facilities; agricultural and livestock farming; citrus processors; chemical manufacturing industry operations; fossil fuel and nuclear power plant operations; pulp and paper mill plants; silviculture; commercial and recreational fishing; municipal wastewater treatment and individual septic-tank effluents; coastal maritime commerce activities, especially at ports; dredging of harbors, docks, navigation channels and pipeline canals; the USEPA dredged-material disposal-site program; and urban expansion. The petrochemical industry operations include oil and gas exploration, development, and production operations; pipeline transport; tanker and barge movement of both imported and domestic petroleum products and crude oils; petroleum and petrochemical refinery and processing operations; and oil-field waste disposal. Section III.A.6. provides more information on the quantities of discharges from each of these activities.

5. Natural Catastrophies

Several kinds of major natural processes create particular problems in the coastal zone. These include the following: hurricanes, which, through high and intense flood surges may breach barrier islands and dunes, flooding low-lying coastal areas; shoreline erosion under storm and normal conditions; inland flooding along floodplains; and surface faulting and land subsidence.

C. OIL SPILLS

Accidental discharge of oil can occur during almost any stage of exploration, development, or production on the OCS. Oil spills occur as a result of many causes (i.e., equipment malfunctions, ship collisions, pipeline breaks, human error, severe storms, etc.). Although many oil spills are not directly attributable to the oil-extraction process, they are indirectly related through the support activities necessary for recovery and transmission of the resource. Of these various potential spill sources, the great majority of accidental discharges have resulted from production activities (NRC, 1985; USDI, MMS, 1986c).

Impacts to sensitive resources from an accidental crude oil spill will depend on such factors as the initial size of the spill; the duration of the spill; whether the spill originated at the seafloor, surface, or at some point in between; the degree of weathering and dispersion that has occurred; and the degree of contact and sensitivity of a resource to the various components of the crude oil. Impacts range from direct effects, such as the smothering of organisms and toxic effects, to such indirect effects as disruption of a critical food source or interference with the ability to attach to a particular substrate. Impacts to a sensitive resource depend on the combination of factors present when the spilled crude contacts that resource. Refer to the analyses in Section IV.A. for a discussion of the variety of possible impacts to any specific resource.

The size of an oil spill can vary greatly from less than one barrel to hundreds of thousands of barrels being released over a period of time as a result of a single event. It is currently unknown if there is a direct relationship between the size of a spill and the event responsible for it. Because of this, discussions of estimates of the number, volume, location, and impacts resulting from accidental oil spills are based on spill size rather than source.

The OCS Lands Act requires the Secretary of the Interior to investigate and prepare a public report on each large oil spill. The MMS has issued regulations (30 CFR 250.41) requiring operators to report all accidents orally to the District Supervisor and to confirm in writing spills greater than one barrel. The report must include the cause, location, volume of spill, and action taken. In the case of spills greater than 50 bbl , the sea state, meteorological conditions, and size and appearance of the slick must also be included in the report.

To support the environmental analyses conducted for this EIS, the breakdown in size categories is different than those stated above. Spill statistics are divided into two major categories, large, and small, based on the requirements of the Oil Spill Risk Analysis (OSRA). Spills of 1,000 bbl or greater are considered large, while all spills less than 1,000 bbl are classified as small. The 1,000-bbl cutoff was selected primarily for two reasons. First, the smaller spills may occur unnoticed offshore and thus not be included in historic databases. Second, large spills are modeled by the OSRA, which requires spills large enough to travel great distances or to remain intact for times of up to 30 days.

The OSRA is a three-step process designed to assess the potential risk of contact of spilled oil with sensitive environmental resources. This assessment is a long-term, statistical approach that is intended to estimate both the likelihood of spill occurrence and the probability of contact with the resources over the estimated 39-year life of the proposed action. The first OSRA step estimates the likelihood that one or more oil spills will occur using a rate based on historic spills and past OCS production. In the second step, the contact probability is estimated from trajectories determined by surface currents driven by processes other than the winds and the surface drift produced by winds on a seasonal basis. The third step combines the occurrence and contact probabilities to estimate the joint likelihood of occurrence and contact for a given resource.

1. Historical Record of Oil Spills in the Gulf of Mexico

a. Small Spills

It was not until 1978 that Congress charged DOI with the responsibility to report publicly on major OCS accidents. However, statistics on oil-spill events occurring in connection with OCS activities have been maintained since 1964 (Krahl, written comm., 1989). Requirements for reporting spills to MMS have varied through time as to size classes reported and protocols for reporting. At present, 30 CFR 250.41 requires that industry report in writing to MMS all spills over one barrel. Because of the historical variations on the reporting requirements for spills of less than 1,000 bbl, the statistics should not be viewed as an accurate record of all possible spills; however, they should be helpful in establishing limits on spill occurrence.

For purposes of this analysis, small spills are defined as spills greater than 1 bbl and less than 1,000 bbl. These spills are further subdivided into two categories--spills greater than 1 bbl and less than or equal to 50 bbl and spills greater than 50 bbl and less than 1,000 bbl. The database on spills less than or equal to one barrel is incomplete because the 30 CFR 250.41 regulations mentioned above makes it unusable; therefore, it will not be considered in the assumptions and discussions described below. Spill sources include pipeline leaks or breaks and platform mishaps. No information is maintained by MMS on small spills from shuttle-tankering operations.

The spill rates of the two categories of small spills defined above are relative to OCS production of crude and condensates data. The spill-rate calculations employed information on the number of spills (Krahl, written comm., 1989) and the adjusted annual OCS production from 1971 to 1988. These spill rates differ from rates calculated for spills of 1,000 bbl or greater (Section IV.C.1.b. below) because they are arithmetic averages rather than rates estimated using statistical and trend analysis techniques. Implementation of improved safety practices in the oil industry has contributed to a reduction of large spill events (Anderson and LaBelle, 1988). Because it is then conceivable that such safety practices may also influence the number of small spill events, these small-spill rates should be viewed as conservative estimates. The small-spill rates for the two categories are as follows:

Spill Size	Spill Rate (spills/billion bbl produced)
greater than 1 and less than 50 bbl	135
greater than 50 and less than 1,000 bbl	5

b. Large Spills

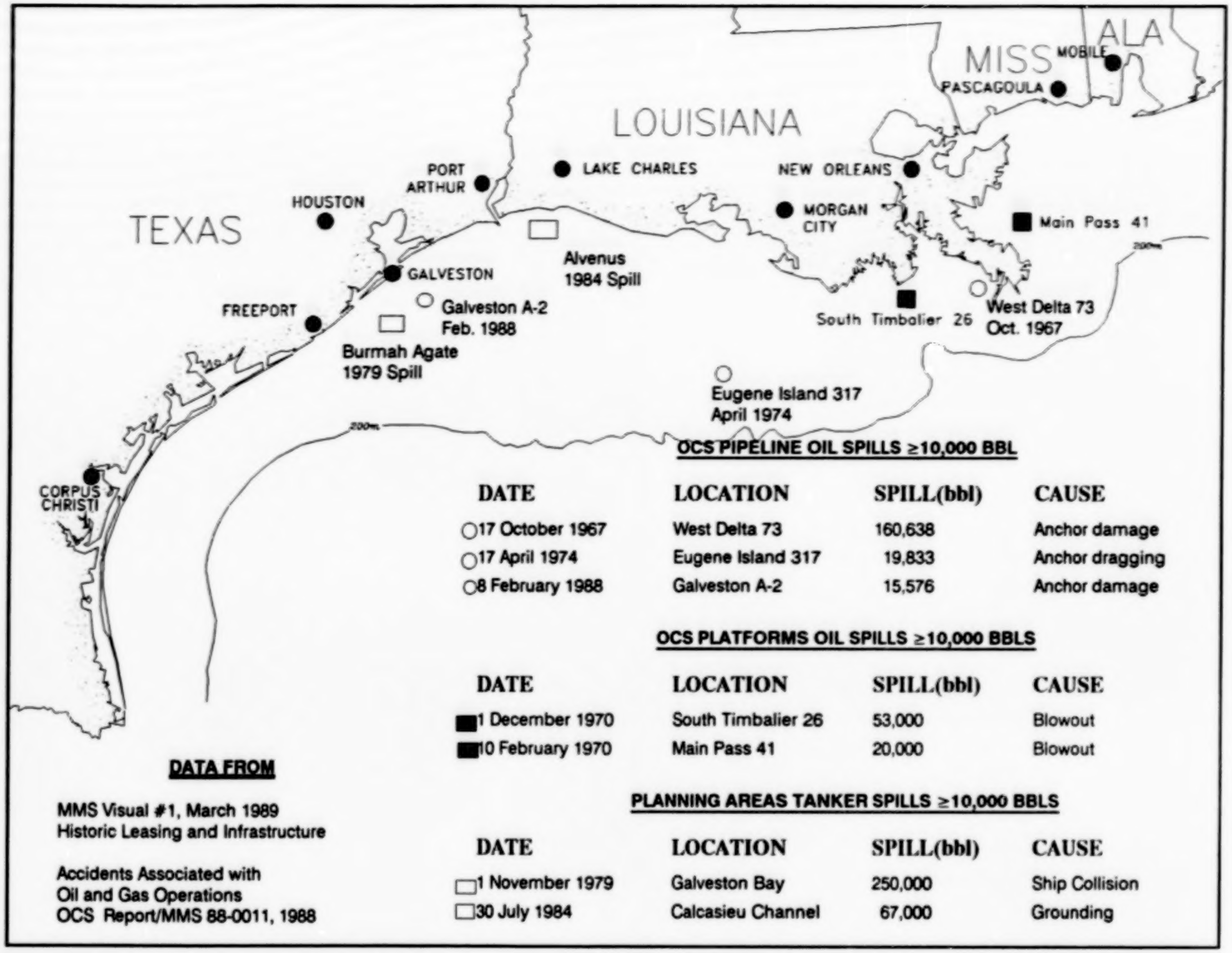
Data on spills of 1,000 bbl or greater have been kept quite accurately since 1964. These spill event data, in conjunction with the historic production of OCS leases, allow the estimation of a spill rate with a significant degree of accuracy. This rate has not been uniform through time, and several revisions have been carried out (Nakassis, 1982; Lanfear and Amstutz, 1983; Anderson and Labelle, 1988). The latest revision (Anderson and LaBelle, 1988) found a decrease in the spill rate of 40 percent for platforms and 50 percent for pipelines. These reductions were attributed to improved safety practices in the oil industry. The revised spill rates are currently employed in the OSRA calculations. The new spill-rate values are as follows:

	Spill Rates (1,000 bbl or greater/billion bbl produced and transported)
Platforms	0.60
Pipelines	0.67
Shuttle Tankering	0.90 (in the Gulf)
Import Tankering	0.45 (in the Gulf)
At Port	0.40

The import tankering spill rate (at sea in the Gulf) is one-half the worldwide tanker spill rate (at sea) and is based on the assumption that 50 percent of the spills related to import tankering will occur on the inbound portion of the journey in the Gulf of Mexico study area.

c. Very Large Spills

A very large oil spill is defined for EIS purposes as a spill of 100,000 bbl or greater. Only one very large spill, a 160,638 bbl pipeline spill, has occurred in the Gulf of Mexico from OCS operations. This spill occurred in 1967 and lasted 12 days, prior to the implementation of more expanded and stringent Federal regulations of OCS activities. From the above discussion it can be inferred that the probability of occurrence of an OCS-related oil spill in excess of 100,000 bbl in the Gulf of Mexico is rather low. The historical record shows that there have been four large spills exceeding 10,000 bbl--two from pipelines and two from platforms (Figure IV-5). The two platforms spills resulted from blowouts, which along with the Santa Barbara blowout incident, prompted the implementation of new and stringent operation regulations pertaining to drilling procedures, subsurface safety valves, and platforms safety devices. Also, the training requirements and inspections by MMS personnel were increased as a result of the above incidents. The two pipeline spills occurred from anchor dragging across pipelines (some of which are shown in Figure IV-6). Besides the four OCS-related spills, two import-tankering spills (non-OCS-related) have occurred in the Gulf of Mexico (Figure IV-5). Most of the very large oil spills have occurred in the WPA and CPA, as can be seen in Figure IV-5. Very large oil spills in the EPA have not been reported. Even though several spills have occurred in this planning area, none have involved OCS production oil and quantities have always been less than 3,000 bbl. A brief description of the spills mentioned above can be found in Sections IV.C.1.c.(1) and (2) below. An analysis of one possible very large oil spill is presented in Section IV.E.



OCS PIPELINE OIL SPILLS ≥10,000 BBL

DATE	LOCATION	SPILL(bbl)	CAUSE
○17 October 1967	West Delta 73	160,638	Anchor damage
○17 April 1974	Eugene Island 317	19,833	Anchor dragging
○8 February 1988	Galveston A-2	15,576	Anchor damage

OCS PLATFORMS OIL SPILLS ≥10,000 BBLS

DATE	LOCATION	SPILL(bbl)	CAUSE
■1 December 1970	South Timbalier 26	53,000	Blowout
■10 February 1970	Main Pass 41	20,000	Blowout

PLANNING AREAS TANKER SPILLS ≥10,000 BBLS

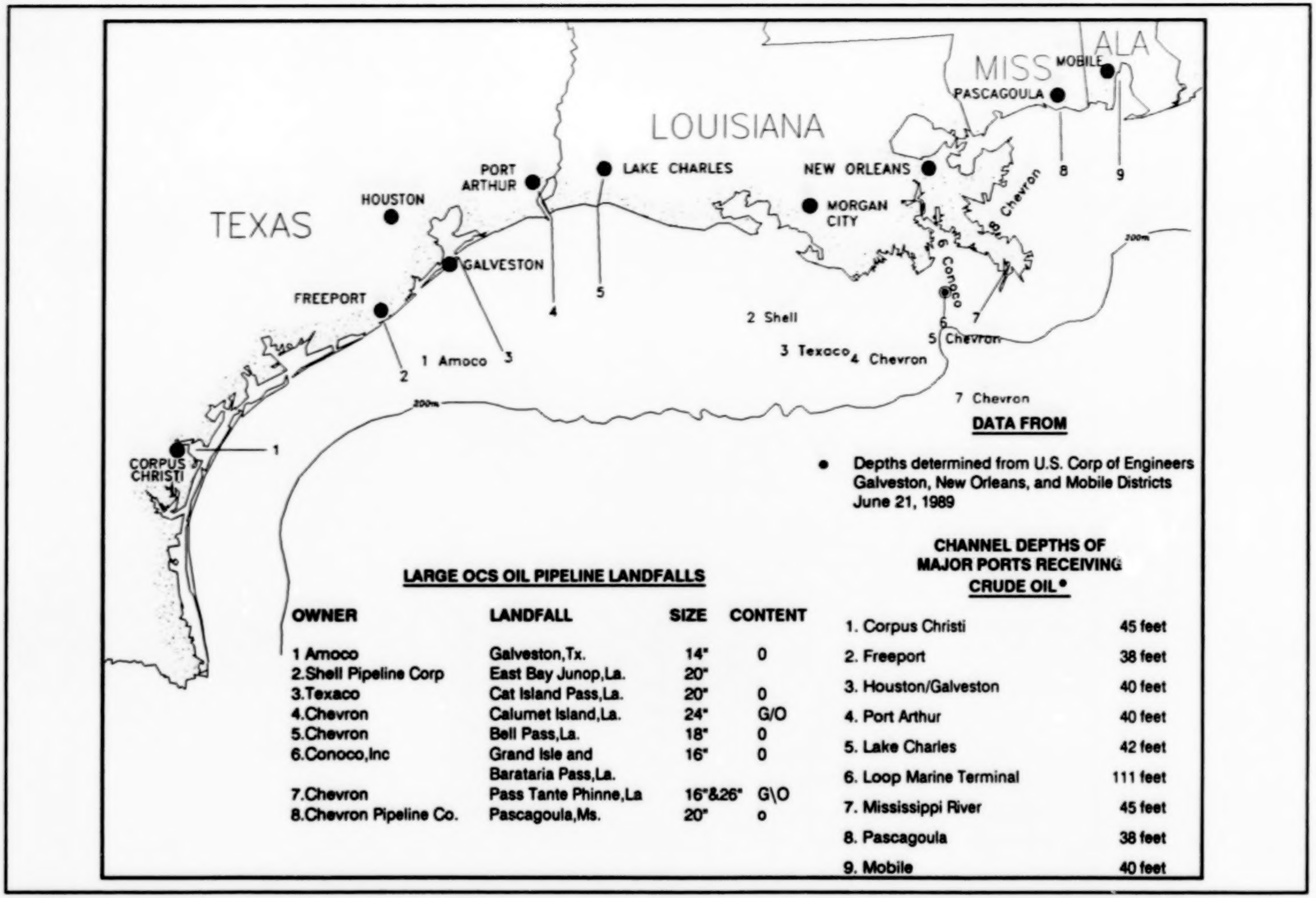
DATE	LOCATION	SPILL(bbl)	CAUSE
□1 November 1979	Galveston Bay	250,000	Ship Collision
□30 July 1984	Calcasieu Channel	67,000	Grounding

DATA FROM

MMS Visual #1, March 1989
Historic Leasing and Infrastructure

Accidents Associated with
Oil and Gas Operations
OCS Report/MMS 88-0011, 1988

Figure IV-5. Large Oil Spills in the Gulf of Mexico.



DATA FROM

● Depths determined from U.S. Corp of Engineers Galveston, New Orleans, and Mobile Districts June 21, 1989

LARGE OCS OIL PIPELINE LANDFALLS

OWNER	LANDFALL	SIZE	CONTENT
1 Amoco	Galveston,Tx.	14"	0
2.Shell Pipeline Corp	East Bay Junop,La.	20"	
3.Texaco	Cat Island Pass,La.	20"	0
4.Chevron	Calumet Island,La.	24"	G/O
5.Chevron	Bell Pass,La.	18"	0
6.Conoco,Inc	Grand Isle and Barataria Pass,La.	16"	0
7.Chevron	Pass Tante Phinne,La	16"&26"	G\O
8.Chevron Pipeline Co.	Pascagoula,Ms.	20"	o

CHANNEL DEPTHS OF MAJOR PORTS RECEIVING CRUDE OIL●

1. Corpus Christi	45 feet
2. Freeport	38 feet
3. Houston/Galveston	40 feet
4. Port Arthur	40 feet
5. Lake Charles	42 feet
6. Loop Marine Terminal	111 feet
7. Mississippi River	45 feet
8. Pascagoula	38 feet
9. Mobile	40 feet

Figure IV-6. OCS Pipeline Landfalls (dotted lines) and Major Ports Receiving Crude Oil (solid lines) in the Gulf of Mexico.

(1) Spills Occurring in Connection with OCS Operations

Main Pass Block 41 Blowout

From February 10 to March 31, 1970, 12 wells producing about 3,000 bbl of oil/day spewed oil and natural gas into the air from the Chevron platform in Main Pass Block 41. A fire of unknown origin had resulted in the loss of control of the 12 wells on the platform. For 1 month, the fire continued and consumed the majority of the escaping oil. After the fire was extinguished on March 10, 30,000 bbl of light crude discharged into the Gulf of Mexico. High-pressure water jets were used to apply dispersants to the oil as it flowed from the platform. Some oil from the platform eventually reached the vicinity of the Chandeleur Islands, but only Breton Island in the Chandeleur chain was oiled. Chevron spent 42 days cleaning the oil from the island with bales of hay and with burning removal techniques. Six months later, only a trace of oil remained on the island. There were no reports of fish, birds, or other animals killed as a result of the spill, and no acute effects to the important fisheries in the area were reported.

South Timbalier Block 26 Blowout

On December 1, 1970, a blowout and ensuing fire damaged 11 wells on Shell Oil Company's South Timbalier Block 26 Platform B, located south of the deltaic plain region of Louisiana. Approximately 53,000 bbl of oil were spilled during the 4.5 months of the accident. Approximately 21,000 bbl of oil were recovered from the water. Chemical dispersants were sprayed on Platform B and into surrounding waters as the oil spilled. The platform was located about 11.3 km (7 mi) from the coastline. Impacts to the benthic fauna were concentrated around a 1-mi radius from the platform. Waterfowl impact was minimal, and no cleaning of birds was required. Beaches between Caminada Pass and Timbalier Island in Lafourche Parish, Louisiana, received some oiling. Whatever oil landed was in emulsified form and was removed from the beach by ground crews using shovels.

(2) Spills Occurring in Connection with Import Tankering

The Burmah Agate Oil Spill

On November 1, 1979, the M/V *Burmah Agate* collided with the freighter *Mimosa* 7.1 km (4.4 mi) southeas of the Galveston Bay entrance in Texas. The collision caused an oil spill and fire in which 250,000 bbl of oil were released between November 1979 and January 1980. Of this spilled volume, 2,500 bbl reached the shore. A total of 1,500 m^3 (1,962 yd^3) of oiled sand and 81,000 gallons of a mixture of oil, sand, and water were recovered from the shore by the end of the spill.

Traces of the oil were found as far as 473 km (294 mi) from the spill site. A 402-m (1,320-ft) section of *Spartina alterniflora* grass and marshland in Galveston Bay was impacted. Cleanup operations were conducted on Galveston Island, but no cleanup operations took place in the marsh areas of Galveston Bay or San Jose Island.

The Alvenus Oil Spill

On July 30, 1984, the *M/V Alvenus* grounded and cracked in Calcasieu Ship Channel, 17.7 km (11 mi) south of Cameron Parish, Louisiana. The grounding split the hull and buckled it upwards, spilling approximately 67,000 bbl of heavy Venezuelan crude oil from the ship for 2-3 days. By August 1, the slick was moving in a west-southwest direction. This movement continued for 5-7 days for a total distance of 100 mi. On August 3-4, a southerly wind pushed the oil slick into the nearshore zone of Galveston Island and Bolivar Peninsula, Texas; and the highly viscous slick was washed into the sands. By August 7, oil was not visible in waters of the Gulf of Mexico. Most of the oil sank to the bottom or formed tarballs in the nearshore zone. Only a small fraction, 75 bbl, of the oil was recovered. A total of 17,000-24,000 bbl were deposited on the shores of Galveston Island and Bolivar Peninsula, of which 6,900-10,000 bbl were in the surf zone. Oil penetrated about 0.13 m (5 in) into the sand, and approximately 69,000-73,000 m^3 (90,000-95,000 yd^3) of sand were removed from the beaches during the cleaning efforts. The total impacted zone was 80.4 km (50 mi) long. Effects on the biota were reported as being relatively minor. Five dead birds and seven birds and one turtle that required oil-removal treatment were reported. Very little damage to mangroves and wetlands occurred, primarily because the currents carried the oil away from these areas. Water-column conditions showed little effects. Most of the immediate discernible impacts occurred to the beaches.

2. Assumptions About the Characteristics, Fates, and Effects of Gulf of Mexico Oil Spills

The impact, behavior, and ultimate fate of an oil spill depend not only on the ambient physical environment but also on its chemical and physical properties. Oil is a complex mixture of thousands of organic and a few inorganic compounds. These compounds include alkanes (aliphatics), naphthenes (cycloparaffinic), aromatics, and asphaltics (asphaltenes and heterocyclic compounds containing oxygen, sulphur, and nitrogen). The following description of the characteristics of crude oil is taken primarily from Geraci and St. Aubin (1988).

a. Chemical and Physical Properties of Gulf Crude Oil

Composition of Petroleum

Included within the classification of petroleum are natural gas, liquid petroleum oils, resins, and asphaltenes. A more precise definition of petroleum is impossible because no two are identical. Most crude petroleums contain the same classes of compounds but differ in the relative amounts of each constituent.

Crude petroleum may contain organic compounds ranging in molecular weight from methane to complex polymeric structures such as asphaltenes with molecular weights of 100,000 or more (Kallio, 1976). Natural gas is separated from liquid petroleum at the time of production; the oil is then distilled to produce commercial products. Each fraction is collected at a different distillation temperature and can be refined further into a product with more desirable properties. The residue after distillation contains much of the resin and asphaltene fractions of the crude oil. It is a thick, tarry liquid or solid that may be used for fuel (Bunker C residual oil, Number 6 fuel) or paving (asphalt).

Hydrocarbons (compounds composed only of carbon and hydrogen atoms) are the most abundant components of crude and refined petroleum. They account for more than 90 percent of natural gas and from 50 percent to approximately 98 percent of liquid crude petroleum (Kallio, 1976; NRC, 1985). Other components include sulphur, oxygen, nitrogen, and a variety of metallic elements that are complexed with organic compounds or exist as inorganic salts.

Alkanes, which contain single chemical bonds between carbon atoms, are the most abundant hydrocarbons in petroleum. There are three types: normal (n-), branched, and cyclic. The normal and branched alkanes are usually present in approximately equal amounts. The n-alkanes typically range in size from (C_1 methane) to about C_{60}, and possibly as high as C_{78}. A majority of the branched or iso-alkanes are simple 2-, 3-, and 4-methylalkanes. In addition, the branched alkanes include a series of hydrocarbons based on isoprenoid building blocks that extend from C_{10} to about C_{40}. The most abundant isoprenoid alkanes in petroleum are pristane (C_{19}) and phytane (C_{20}). Cycloalkanes, also called cycloparaffins or naphthenes, may account for as much as 50 percent of the total hydrocarbons in oil. Most are cyclopentane derivatives. They may contain aromatic ring or normal or branched alkane substituents, or nonhydrocarbon groups, such as one or more carboxylic acid moieties.

Aromatic hydrocarbons may account for about 20 percent of the total hydrocarbons in crude oil. The basic building block of an aromatic hydrocarbon is the benzene ring, a six-member carbon ring containing nine equally shared carbon-carbon covalent bonds. Benzene occurs in small amounts in natural gas, crude, and particularly the lighter fractions of refined oil. It may be linked to another benzene ring through a single carbon-carbon bond to form biphenyls. Polycyclic aromatic hydrocarbons (PAH's) are composed of two to nine or more fused benzene rings (Neff, 1979). Naphthalene ($C_{10}H_8$), which consists of two fused rings, is the lowest molecular weight PAH. The abundance of aromatic hydrocarbons in petroleum usually decreases markedly with increasing molecular weight. In most cases, the one-ring (benzene) through three-ring (phenanthrene) compounds account for at least 90 percent of the aromatic hydrocarbons (Neff, 1979). These may combine with cycloalkanes to form naphthenoaromatic compounds and combine further to produce polymeric structures, which are important components of the resin and asphaltene fractions of petroleum.

The resin and asphaltene fractions of crude oil have not been well characterized (Kallio, 1976). They presumably consist of high-molecular-weight hydrocarbons and heterocompounds containing sulphur, oxygen, or nitrogen and thermally induced condensation products of lower molecular-weight aromatics and heteroaromatics. Asphaltenes are thought to be present in colloidal suspension.

South Louisiana Crude

South Louisiana crude is a typical crude oil from the Central Gulf of Mexico. The properties of an API reference South Louisiana crude oil are provided in Table IV-12. Table IV-12 represents values for typical crude oils from different geographical regions. Variations in composition can be expected for oils produced from different formations or fields within a region. A review of 92 crude oils produced from fields on the Central Planning Area OCS and coastal Louisiana shows that a majority (51%) of the crude oils have API gravities between 33° and 38° API. However, the range of variability is great, with the lowest being 21.6° and the highest being 47.3° API.

Florida Crudes

Not as much is known about Florida crudes since no production has occurred yet in the OCS. Three source rock potentials have been identified in Florida basins. Petroleum has been produced in southern Florida from the Sunniland Trend from State leases and is characterized in Table IV-12. The bulk composition of oils produced from the Sunniland Trend fall between those considered aromatic-intermediate and those termed paraffinic-naphthenic. They are of low API gravity (19°-27°API), have high sulphur contents (2.6%-4.5%), and have evidence of very small amounts of gas in solution (Montgomery, 1987). In the Florida Panhandle, oil is hoped to be found in the Smackover Formations, and there is a probable find in the Norphelet Trend.

b. Short-term Weathering Processes

A number of processes occur when oil is spilled in water, altering the chemical and physical characteristics of the original oil mixture. Collectively, these are referred to as weathering or aging of the oil and will determine, along with physical oceanography, the fate of the spilled oil. Weathering involves a number of physical/chemical and biological processes that change the characteristics of the crude-oil mixture and reduce the concentration of oil components in the slick. These processes include evaporation, dispersion, dissolution, emulsification, biodegradation, photo-oxidation, sinking, and sedimentation. Any or all of these processes can be expected to operate on spilled oil. Their relative importance depend largely on oceanographic and meteorological conditions at the time of the spill. Eventually, a tar-like residue may be left, which would break up into tar lumps or tarballs. Types of weathering processes and transport pathways of spilled oil at sea are depicted in Figure IV-7.

Slick Residence Time

Spilled Louisiana crude disperses and degrades rapidly under the influences of the Gulf's warm climatic conditions and due to the properties of the oil. Because Louisiana crude evaporates rapidly, slicks observed in Gulf waters have disappeared within days. Very few oil slicks have ever been tracked for more than 30 days. (Spills from the *Torrey Canyon* tanker, *Amoco Cadiz* tanker, and the *Ixtoc* blowout accidents, which released oil over a long time period, remained on the sea surface longer than 30 days, but the volumes spilled were many times larger than the median spill described in this EIS.) For example, a slick from South Pass Block 60 of 42,000 bbl, spilled on August 2, 1973, was reported dissipated with only small patches remaining after only 5 days. In examining the Chevron Main Pass blowout, only 50 percent of the oil lost could be accounted for--25-

Table IV-12

Gulf of Mexico Crude-Oil Characteristics

Central and Western Gulf of Mexico

South Louisiana Crude

API	Gravity (20°C)	34.5
wt%	Naphtha Fraction (boiling from 20 to 150°C)	18.6
wt%	Saturates - High boiling	56.3
wt%	Aromatics - High boiling	16.5
wt%	Insolubles	0.2
wt%	Polar Materials	8.4
wt%	Sulphur	0.25
wt%	Nitrogen	0.69
ppm	Nickel	2.2
ppm	Vanaduim	1.9

Source: Jordan and Payne, 1980.

Eastern Gulf of Mexico

Sunniland Mix

API	Gravity	25.1
volume%	Naphtha Fraction[1]	20.2
volume%	Kerosene[2]	12.4
volume%	Light Gas Oil[3]	11.3
volume%	Process Gas Oil[4]	34.3
volume%	Residuum[5]	20.2
wt%	Sulphur	

[1] Boiling at 0-191°C.
[2] Boiling at 191-277°C.
[3] Boiling at 277-343°C.
[4] Boiling at 343-565°C.
[5] Boiling >565°C + residuum.

Source: Frazer, personal comm., 1989.

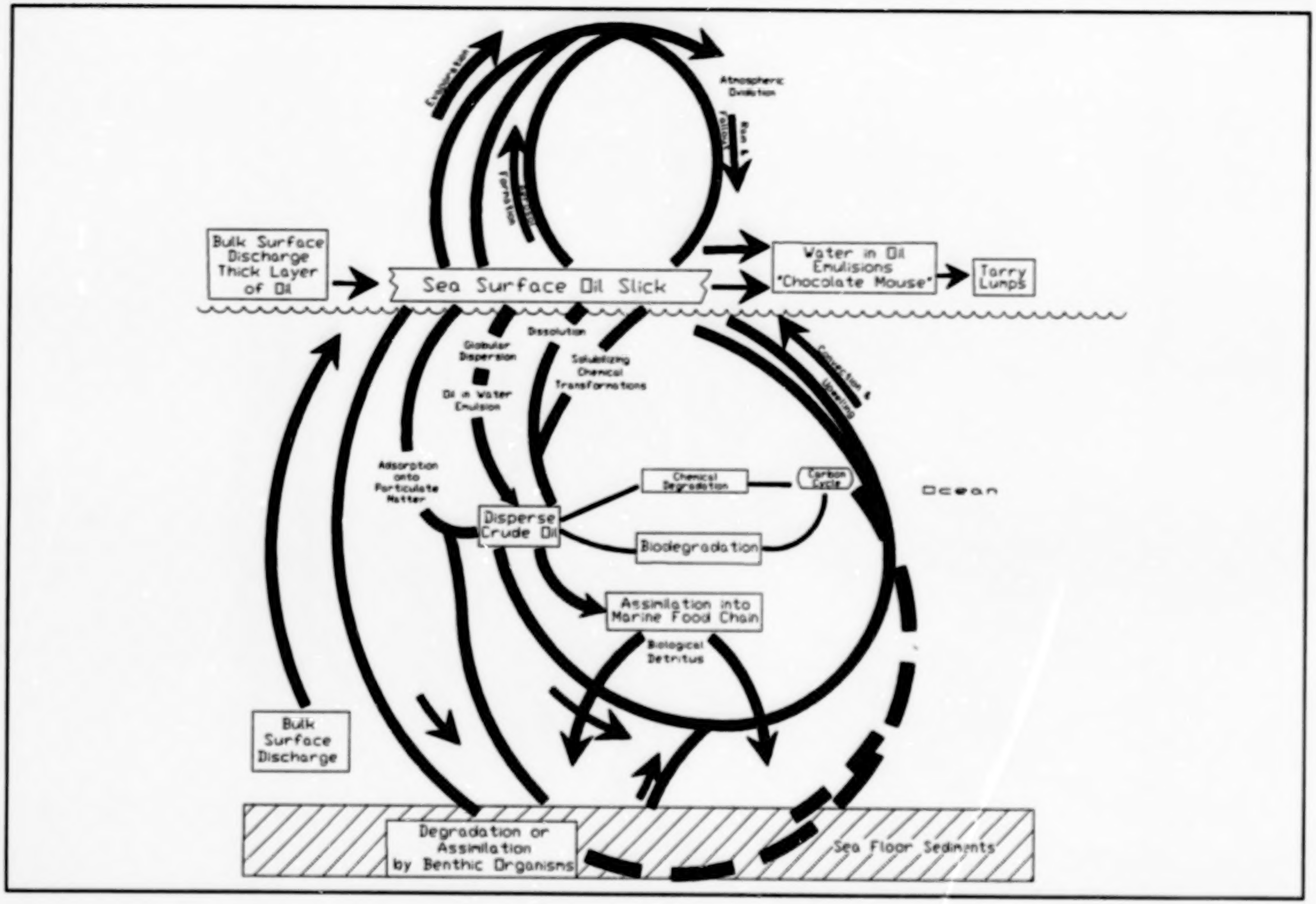


Figure IV-7. Processes Affecting the Fate of Spilled Oil (reprinted from Jordan and Payne, 1980).

30 percent of the oil was estimated lost due to evaporation, 10-20 percent of the oil was removed from the sea surface by skimming and other recovery techniques, less than 1 percent was believed dissolved in seawater, and less than 1 percent sunk and was deposited in the sediment within an 8-km radius of the well. Evidently, the remaining oil became emulsified and dispersed to undetectable levels (less than 1 ppm) or became biodegraded and/or photo-oxidized (McAuliffe et al., 1975). Dispersants were used in the cleanup operations and also in the water sprayed on the burning platform to help disperse the oil. Based on the above, 10 days, is chosen as the most likely sea-surface residence time. Research regarding dominant weathering processes indicate that after 10 days the oil properties have changed extensively and the original volume has decreased greatly (Table IV-13). The floating oil is largely devoid of its volatile (acutely toxic) components; the slick is breaking up, and much of the oil may be emulsified (Wheeler, 1978).

(1) Weathering Processes (less than 10 days)

Spreading

After a spill occurs, a "slick" forms because of the low solubility of most petroleum components. Principal forces influencing the spreading rate of a slick are gravity, viscosity, net surface tension, inertia, and turbulence of the water body. By far, spreading of the oil to a thin film is the most important process because spreading enhances the ability of other weathering processes to act on the slick. The slick is not a uniform film but has a thick part of a few millimeters and a thin outer part that can be of a thickness of about 0.01 um (a monomolecular layer).

Evaporation

The more volatile hydrocarbons are lost to the atmosphere during the first 24 hours. In 10 days, oil is devoid of components with boiling points less than 270°C, which include all n-alkanes less than C_{15} and certain aromatics including the benzene, toluene, and sylene fractions. Evaporation increases with increasing wind speed and water temperature. Based on an analysis by Torgrimson (1981), 48 percent of a typical medium-light crude oil would be lost due to evaporation.

Dissolution

Low-molecular-weight compounds, particularly aromatics such as benzene and toluene, will rapidly dissolve in the water column. Dissolution occurs directly from the floating slick and from dispersed oil in the water column. The extent of dissolution is influenced by the oil's aqueous solubility, which, for crude oil, is typically 30 mg/L (NRC, 1985). The process is in competition with evaporation, which is orders of magnitude faster, so many soluble compounds are preferentially removed by evaporation.

Dispersion

The agitation of oil slicks due to the breaking of waves, the action of the surf, and the surface turbulence supply the energy to drive oil into the water column, forming small droplets of stable emulsions from 5 micrometers to several millimeters in size that are dispersed into the water column (oil-in-water emulsions). Larger oil droplets probably rise and coalesce with the slick, while the smaller oil droplets are conveyed and permanently incorporated into the water column (NRC, 1985). This process, along with evaporation, largely determines the lifetime of a slick.

Table IV-13

Mass Balance of a Typical Gulf of Mexico Crude Spill[1]

Process	Time Scale (in days)	% Loss of Original Slick Volume (10 days)	% Loss of Original Slick Volume (30 days)
Evaporation	1-10	33%-67%	33%-67%
Dissolution	1-10	1%-5%	1%-5%
Dispersion	1-30	10%-15%	included in sinking and sedimentation rate
Photo/Auto-oxidation	3-365	<1%	5%
Biodegradation	5-720	1% and sedimentation rate	included in sinking
Sinking and Sedimentation	10-365	<1%	20%-34%
Tar Residue	10-365	<1%	1%-30%
Offshore Skimming and Recovery Cleanup Operations		10%	15%
Total Volume Loss from Water Surface		56%-98%	100%

[1] It is assumed that the spill does not contact land.

Source: USDI, MMS, Gulf of Mexico OCS Region estimates, 1989.

(2) Weathering Processes (greater than 10 days)

Emulsion Formation/Mousse

Because most of the components of petroleum are relatively insoluble in water, an important process in weathering of the slick is the formation of emulsions. Facilitated by increased viscosity and density due to evaporation and dissolution, the heavier fractions of oil take on a highly viscous consistency caused by the formation of a water-in-oil emulsion termed "mousse" because of its color and consistency. These emulsions that contain 30-80 percent water are dispersed easily by currents and turbulence at the water surface. Naturally occurring surfactants in the petroleum-asphaltene fraction tend to assist in the formation of emulsions. Emulsification impedes cleanup operations and slows down the weathering process by limiting the exposed surface area.

Sedimentation

Sedimentation of the dispersed or surface emulsified oil occurs once an increase in density is sufficient to sink the material. Processes increasing density include evaporation and dissolution of the lighter compounds; formation and agglutination of dispersed particles followed by uptake onto particulate sediment; and sorption onto particulate matter such as fine-grained sediments, biogenic skeletal remains, detritus, phytoplankton, or fecal pellets of organisms. Residence time at the sediment/water interface is controlled by the rate of biodegradation and rate of burial by burrowing organisms and sediment accumulation (Kolpack et al., 1978).

In Gulf coastal areas characterized by fine-sediment salt marshes or influenced by the Mississippi River's large sediment plume, the amounts of suspended particles in the water are high, and oil in this turbid area is soon carried to the bottom.

None of the above processes actually remove petroleum compounds from the environment; they only redistributes them, dispersing the oil to very low concentrations.

Chemical Reactions/Oxidation

Spilled oil undergoes chemical changes such as photo- and auto-oxidation, producing a number of products including CO_2, carboxylic acids and diacids, esters and lactones, aldehydes, alcohols, hydroperoxides, phenols, sulfoxides, and combinations of these products. Besides influencing the solubility of the components of oil spills, oxidation enhances dispersion and emulsification. The effects of oxidation are complex and may be partially beneficial and partially deleterious. Photo-oxidation of simulated spills in the laboratory have produced more soluble and more carcinogenic and mutagenic oxygenation products. Oil will also react to form polymers, which are usually less toxic than the smaller oil molecules. Both oxidation and polymer formation are active in tar residue formation.

Biological Processes

Biological processes include biodegradation and ingestion by zooplankton and larger forms of marine organisms.

The order of rates of biological degradation of petroleum is as follows: alkanes greater than isoalkanes greater than cycloalkanes greater than aromatics. Some microbial species attack specific aromatic and naphthenic compounds, especially those with side chains. The asphaltene fraction is the most resistant. The rate of decomposition is dependent on the nature and abundance of the indigenous microbial assemblage, the available inorganic nutrients and oxygen, and the ambient temperature.

Bacterial decomposition of oil is the most important long-term, process removing spilled petroleum compounds from the environment. Biodegration of hydrocarbons occurs on the sea surface, in the water column, in the bottom sediments, and on the coast once the oil is beached.

Microbial activity needed for the degradation of oil is influenced by several factors. Microorganisms active in the degradation of oil require oxygen so oil incorporated into anaerobic sediments would undergo very little microbial degradation (Ward et al., 1990). The abundance and physiological types of hydrocarbon-oxidizing microbes are also influenced by the quantities and kinds of hydrocarbons that have been present. Gulf Coast sediments and southern California harbors exposed to chronic oil pollution have yielded from 100 to 1,000,000 oil oxidizers per ml, while clean beach sand and open ocean water often yield none (Zobell, 1973). Furthermore, even in the presence of large amounts of petroleum, microbial degradation of hydrocarbons after the *Exxon Valdez* oil spill, scientists successfully added fertilizer to enhance microbial growth (USEPA, 1989), and bioremediation of the spilled oil proved one of the most effective cleanup techniques used.

South Louisiana crude oil showed the highest rate of degradation in numerous studies conducted on biodegradation rates of different oils (Zobell and Prokop, 1966). Jeffrey (1977) states that in 1977 Walker and Colwell found as high as a 97 percent loss of oil in only 30 days from Louisiana sediments due to bacterial degradation in one instance.

Tar Residue Formation

Natural weathering and degradation processes can remove nearly all of the original volume of the spilled surface slick within 30 days. The residue left behind resembles the original material very little. The resulting tarry residue will break up into smaller fragments from continuing wave action and form tarballs. Further degradation is slowed down since the surface-to-volume ratio of unspread tar is small, and the remaining components are more chemically resistant. Ingestion of floating tar by copepods and subsequent excretion increases its density and aids in sedimentation.

Butler et al. (1973) found that around 30 percent of most oil discharged to the ocean remains in the form of tarballs or lumps. In contrast, Louisiana crude and some other northern Gulf coast crudes do not seem to form tarballs (Jeffrey et al., 1974) because of low asphaltene and nitrogen-sulphur-oxygen (NSO) components. Tarball formation would be limited to spherical accretion caused by persistent convergence and supply to the oil residues (Heaton et al., 1980). Spills from the EPA may form a significantly higher percentage of tar material because of the different chemical compositions of the oil.

(3) Subsurface Plume Formation

When initially spilled, most crude oils float. However, some of the spilled oil is dispersed into and retained in the water column. The weathering mechanisms that result in surface oil being retained in the water column include dissolution, dispersion, sinking, and sedimentation. The *Ixtoc* subsurface spill resulted in higher concentrations of oil in the water column than usually measured beneath surface slicks. It was theorized that a new mechanism--subsurface plume formation--was responsible for the phenomena. Subsurface spillage is discussed in the next section.

Approximately 1-10 percent of the volume of the surface slick is predicted to occur in the water column in the vicinity of the spill (Mackay et al., 1979; Rhode Island, University of and Applied Science Associates, 1981; Boehm and Fiest, 1980a). The relative amount of oil that resides in the water column is a function of a number of factors, including the chemical and physical nature of the oil, the point of release (surface versus subsurface), and the hydrographic conditions affecting the slick formed (particularly the sea-surface turbulence). The location of subsurface oil is governed by its physical characteristics and the density stratification of the water column. The submerged oil is often associated with strong temperature and salinity gradients.

Fiest and Boehm (1980) reviewed the literature and found that the average reported concentrations of oil in water generally were less than 1 ug/l for pristine areas, 2-100 ug/l for spills occurring in nearshore areas, and 100-800 ug/l in heavily polluted urban environments. General background values for the Gulf of Mexico were from nondetectable to 70 ug/l. The higher value indicates a chronic paraffinic oil intrusion.

The concentrations of oil in the water column measured around the site of the *Ixtoc* blowout ranged from values of less than 5 ug/l at a distance of 80 km from the blowout to peak values of 10,600 ug/l within a few hundred meters of the wellhead. The highest concentrations were observed within 25 km of the blowout in the top 6 m of the water column (Fiest and Boehm, 1980).

Subsurface Spills

Historically, analyses of the fate of spilled oil assume that the oil originates on the surface of a water body. However, oil spillage could occur from underwater pipelines or subsurface blowouts associated with OCS oil industry activities. The following information is based mainly on the results of a large effort undertaken by the research teams studying the *Ixtoc* blowout (Payne et al., 1980a and 1980b; Fiest and Boehm, 1980; Boehm and Fiest, 1980a and 1980b; Walter and Proni, 1980). The *Ixtoc I* subsurface blowout occurred offshore Mexico on June 9, 1979, spilling approximately 10,000 bbl a day until capped in March 1980. This spill provided the first major opportunity to focus studies on the subsurface transport processes affecting spilled petroleum.

Subsurface Plume Formation

Fiest and Boehm (1980), Walter and Proni (1980), and others examined the characteristics of the *Ixtoc* blowout. They determined that a significant quantity of the oil released formed a subsurface plume of oil droplets found suspended in a mixed layer at depths of 5-20 m. The subsurface petroleum plume, representing approximately 3 percent of the spilled oil, was transported by ocean currents (Boehm and Fiest, 1982). An oceanic frontal system may have acted as a barrier to the lateral transport of the oil plume and may also have acted as a conduit for the subsurface movement of oil along the frontal axis. Within 5 km from the wellhead, the subsurface plume was made up of oil droplets greater than 0.45 um and had petroleum hydrocarbon concentrations greater than 600 ug/l. Such whole oil was found at concentrations greater than 20 ug/l at 20 m depths within 25 km from the well (Fiest and Boehm, 1980). Although there appeared to be unidentified processes controlling the transport of the subsurface plume, which differ from those controlling the movement of the surface slick, the subsurface plume was, for the most part, aligned with the surface slick.

Water samples taken from this subsurface plume were considerably enriched in light aromatic hydrocarbons relative to other aromatic components, presumably due to the presence of considerable quantities of soluble, solubilized, or colloidal material in the water. These light aromatic hydrocarbons are usually lost to the atmosphere because of the evaporation of oil spilled on the ocean surface. The fact that the subsurface oil could be characterized by a different chemistry and weathering regime implies that the subsurface oil is a "fresh" oil plume that has remained subsurface since its discharge and in which evaporative loss of aromatics was greatly decreased (Boehm and Fiest, 1980a).

Of particular importance is the fact that concentrations of some of the more toxic components appeared in the water column in sizable amounts because the oil components found in the water included both the usual dissolved and dispersed fraction and this subsurface plume. The concentrations of individual hydrocarbons in the dissolved fraction (0.01-3 ppb) measured in a study of the *Ixtoc* spill (Boehm and Fiest 1980a) appeared to lie below the toxic range, even in the acute impact zone. However, the total concentration of waterborne low-molecular-weight aromatics (alkyl benzenes and naphthalene compounds) in the water fell in the 0.5-500 ppb range, and concentrations of total waterborne oil dispersion were in the 100-10,000 ppb (0.10-10 ppm) range. The researchers report that these values fall well within the range, causing observable effects on marine organisms.

c. Long-term Fate

Natural weathering (evaporation, dissolution, photo-oxidation, and microbial oxidation) and degradation processes will remove nearly all of the original volume of the spilled surface slick within 30 days (Wheeler, 1975). Any tarry residue left behind will break up into smaller fragments from continuing wave action and form tarballs in the water column. Further degradation is retarded since the surface-to-volume ratio of unspread tar is small and tarballs are resistant to microbial degradation; therefore, their lifetime could be on the order of several months to years (Geyer, 1980). Some tarballs reach the coast. An average of 14,000 bbl of floating tar exist in the Gulf of Mexico (Geyer, 1981).

Interaction with Shoreline

The distribution and long-term fate of an oil slick once it contacts land is a function of weathering processes and coastal geomorphology, the kinetic energy of the area, the thickness of the beached oil, and the porosity of the shoreline sediments.

Oil coming ashore into tidal flats, mangrove swamps, or salt marshes could be spread farther inland by each tidal movement and wave action (e.g., Jackson et al., 1989). Once entering inland waters, the oil could either spread out into a thin film or reach areas sheltered from waves and tidal currents and form a thick layer of oil that can remain for years. In particular, oil washing ashore into mangrove swamps could penetrate deep within the swamp area.

Most oil that will reach the Gulf of Mexico shoreline would contact fringing beaches and barrier islands. The distribution and physical dispersion of an oil slick once it contacts a coastal beach is dependent upon the level of kinetic energy of the coastal environment. Often, oiled beaches are cleansed by the natural action of abrasion and sediment scouring by wave activity. Much of the oil beached on the Texas shoreline from the *Ixtoc* blowout was removed during a hurricane. Stranded oil can be washed back out to sea and can be rolled along the bottom in the shallow-water zone by waves and currents, eventually either emerging somewhere else along the shoreline; washing back onshore in the form of hard, tarry masses (tarballs); or resting offshore in the intertidal zone. Some beached oil becomes buried by the rapid changes in beach morphology that occur from natural cycles of erosion or from deposition of migrating beach sands. The depth of oil burial and the thickness of oiled sediments increases as the grain size increases. Although the entire sand column may become lightly contaminated, most of the oil exists in a highly concentrated band of oil-impregnated sand that can persist for years. These buried oil layers have been shown to migrate downwards within the beach sediment, eventually stabilizing deep within the beach at or near the water table or reaching an impermeable layer and migrating along the layer until emerging in the lower intertidal or subtidal sediments at the foot of the beach (Long et al., 1981). Rates of migration of buried oil studied after the *Amoco Cadiz* spill ranged from 0.25 to 1.0 millimeters per tidal cycle. According to Long et al., these rates agree with rates determined experimentally for a variety of sediment types.

In the 1970 South Timbalier Block 26 oil spill of 53,000 bbl, the self-cleaning phenomena of south Louisiana beaches was the most effective means of removing oil from the beaches. The beaches cleaned themselves in a few days after oil was deposited due to (1) the sand being hard packed and, therefore, resistant to penetration by oil and emulsified oil and (2) the beaches were narrow and shallow; therefore, they were easily swept clean by the changing tides (Berry, 1972).

Ultimate Fate--Recovery of a System

The ultimate fate of environmentally dispersed petroleum in open water is poorly understood. A study by Energy Resources Co. for BLM (1982) found no *Ixtoc* oil in offshore South Texas OCS (STOCS) sediments. Only 2 percent of the oil spilled from the *Ixtoc* blowout was ever accounted for (either found on beaches or residing offshore in tar mats). Perhaps 5-10 times as much oil passed through the Texas OCS region, largely in the form of small patches of emulsified oil. The researchers believed the oil could be tied up with the mobile, suspended sedimentary material (nepheloid layer) that exists near the bottom sediment/water interface or ultimately found its way onto the slope and abyssal plain.

Based on information about Gulf Coast oil spillage, concentrations of spilled petroleum that reach coastal sediments are assumed to be degraded to background levels within 1-2 years (Brown, 1980; McAuliffe et al., 1975; Butler et al., 1976). At present, an MMS study analyzing the effects and fate of the Panamian oil spill is ongoing. Results of this study should contribute to our knowledge of oil spill impacts to tropical environments (Section IV.D.3.a.(2)). Few long-term damage-assessment studies of Gulf oil spills have ever been conducted; however, information known about the ultimate fate of spills that have occurred in the Gulf shows rapid losses. In examining the 1970 Chevron, Main Pass Block 41 blowout, only 50 percent of the oil lost could be accounted for--25-30 percent of the oil was estimated lost due to evaporation, 10-20 percent of the oil was removed from the sea surface by skimming and other recovery techniques, less than 1 percent was believed dissolved in seawater, and less than 1 percent sunk and was deposited in the sediment within an 8-km radius of the well. Evidently, the remaining oil became emulsified and dispersed to undetectable levels (less than 1 ppm) or became biodegraded and/or photo-oxidized (McAuliffe et al., 1975). Dispersants were used in the cleanup operations and also in the water sprayed on the burning platform. Oil identified in nearshore sediments from this blowout showed rapid weathering after 1 week to 1 month, and at the end of 1 year was reduced to a few percent of the amount found immediately after the spill impact. Spilled oil was not found in the sediment below 4 cm. By 6 months, beached oil from the same spill had been weathered to such an extent that just a slight trace of oil remained in Louisiana coastal sediments. In contrast, crude oil spilled in the Marquesas Keys, Florida, in 1975 was reduced to very low levels but still persisted after 1 year on rocky shore and mangrove-marsh substrates.

d. Toxic Effects of Oil Spills

Most of the historical oil spills that occurred in connection with OCS oil industry operations in the Gulf have probably resulted in no serious, short-term, deleterious effects. This conclusion is based on a review of the sparse documentation of the effects of Gulf of Mexico oil spills and on the rapidity with which Louisiana crude disperses and degrades.

Each spill is a unique event, with a number of factors interacting to determine its effects; however, all spills occurring in the Gulf could be potentially harmful. The variability documented in the literature regarding environmental effects of oil spills is due to differences in oil components, environmental conditions, and the organisms encountered. The most damage from an oil spill occurs if a spill from the open ocean reaches confined, shallow water bodies where waterfowl or aquatic organisms are concentrated.

The ultimate impact and recovery of an ecosystem from petroleum contamination depend on the physical and chemical form of the oil and the state of the ecosystem at the specific time of impact. The movement of oil into the water, its chemical changes, its effects on aquatic organisms, and its persistence in the sea are all influenced by (1) the type and characteristics of the oil (for example, its viscosity and percent aromatics); (2) the amount and duration of oil spilled; (3) sea state, in particular the tidal cycle and wave activity; (4) the location of the spill, including the physiography of the area and the distance from shore; (5) the geographical and topological configuration of the affected coast, including textural characteristics of shore sediments; (6) the climatic conditions, in particular temperature, wind, and solar radiation; (7) the biota of the area; (8) the season of the spill; (9) the previous exposure of the area to oil; (10) the area's exposure to other pollutants; and (11) the effectiveness of oil response measures taken.

Short-term effects of oil spills that result in biological loss occur by direct kill through coating and asphyxiation; by contact poisoning or by incorporation of water-soluble toxic, carcinogenic, or mutagenic components of oil; by destruction of the generally more sensitive juvenile forms of organisms or of the food source of higher trophic species; and by modification of habitats, delaying or preventing recolonization (Blumer, 1971).

Toxic Effects

The toxicity of petroleum to marine organisms is dependent on the concentration and composition of its individual hydrocarbons and the exposure length of the various components. The toxicity of the oil will be altered as it weathers, as a result of the changes in its chemical composition.

The oxidized derivatives of petroleum hydrocarbons that are generated during weathering are usually more water soluble than the parent hydrocarbons. Little information is available on the toxicities of these oxidized compounds, which may reach high concentrations in seawater. However, in 1982, experiments were performed by Malins et al. of the Environmental Conservation Division of NMFS (Malins et al., 1982a).

Cook Inlet Crude Oil (CICO) was used during the NMFS experimentation. This oil had an API gravity near 26.5, which is similar to the Sunniland Crude API gravity found in the southeastern Gulf of Mexico. However, the experiments were performed at temperatures far below those that would be experienced in the Gulf and on animals not found in the Gulf. Therefore, these experiments have limited application to any conclusions regarding toxicity and effects on living resources in the Gulf of Mexico.

It was shown that seawater-accommodated fractions (SWAF) of experimentally weathered crude oil did not induce high levels of mortality in fish larvae during laboratory exposures (Malins et al., 1982a). Simulated environmentally weathered crude oil produced little or no mortality on newly hatched fish. However, there was an indication of slight behavior alterations in larval swimming behavior. These behavior alterations could be considered detrimental to larval conditions under natural conditions. When unhatched embryos were exposed to simulated environmentally weathered crude oil at concentrations of 50 to 100 ppb, cytopathological changes were produced. Survival of larvae hatched from the oil-exposed embryos was only 20 percent of control survival.

Due to these observations, Malins et al. (1982a) hypothesized that toxic compounds were not bioavailable. They attributed the unexpected low toxicity of the SWAF from simulated environmentally weathered crude oil, in part, to the formation of charged aggregates (stabilized by oxidized structures), which were not readily accumulated by the exposed marine organisms.

Crude-Oil Characteristics

Some crude-oil compounds are highly toxic and can cause damage to tissues of marine mammals and fish. In general, the toxicity of an oil is directly proportional to its aromatic content (Geraci and St. Aubin, 1988). The lower molecular-weight aromatic components (such as benzene and toluene) are considered acutely toxic but are rapidly lost through evaporation and dissolution during the first days of a spill (Wheeler, 1978). Intermediate tmolecular-weight aromatic hydrocarbons have been found to be toxic to phytoplankton and many species of aquatic animals; naphthalenes and phenanthrenes are slightly soluble and relatively persistent and contribute most to the toxicity of crude oils (Anderson et al., 1974).

Chronic sublethal effects of petroleum rather than toxic effects are attributed primarily to four- and five-ring aromatic and heteroaromatic hydrocarbons, some of which are known carcinogens (Geraci and St. Aubin, 1988; Blumer, 1971). Higher molecular-weight aromatics act as slower poisons than low-boiling aromatics but can be severe in their effects. These and the toxic nitrogen-sulphur-oxygen compounds, as well as most heavy metals found in crude oil, will tend to remain in the tarry residue.

Comparative Toxicity of Oil Types

Toxicities vary between oil types because of variations in the concentration and composition of individual hydrocarbons. In general, refined oils are considered more toxic than crude oils due to a higher concentration of aromatic hydrocarbons and their greater ability to dissolve and disperse into the water column as a result of their less viscous nature. In general, spills of crude oils, residual fuel, and lubricating oils are more likely to cause biological damage by virtue of their viscous physical properties when considered over a relatively long length of time, while spills of refined oil, including gasolines and kerosenes, are likely to cause biological damage by virtue of their toxic nature over a relatively short period of time (Ottway, 1976).

Comparative Toxicity of Different Oil Forms in Water

Although laboratory toxicity tests show that the deleterious effects of oil are related to its chemical components, the form of the oil while at sea or stranded on the coast may be as important. The portion that dissolves appears to be highly toxic to organisms, possibly due to the rapid uptake of oil in this form (Winters and Parker, 1977). Oil in dispersed droplets may exhibit slightly less toxicity than the dissolved fraction. Water-in-oil emulsions of spilled oil are likely to cause biological damage due to physical effects, while oil-in-water emulsions probably cause more biological damage due to toxic effects.

In 1982, a series of experiments was performed by the Environmental Conservation Division of NMFS. These experiements were conducted using Cook Inlet Crude Oil and focused on the enzyme systems of marine organisms that convert aromatic hydrocarbons to their electrophilic metabolites (Malins et al., 1982b). The experiments assessed the uptake, metabolism, and disposition of various hydrocarbons, such as benzene, naphthalene, anthracene, and benzo(a)pyrene in marine organisms, with special emphasis on tissue concentrations of hydrocarbons and their metabolites and the types of metabolites formed *in vivo*.

The Cook Inlet Crude Oil had an API gravity near 26.5, which is similar to the Sunniland Crude API gravity found in the southeastern Gulf of Mexico. However, the experiments were performed at temperatures far below those that would be experienced in the Gulf and on animals not found in the Gulf of Mexico. Therefore, these experiments have limited application to any conclusions regarding toxicity and effects on living resources in the Gulf of Mexico.

Marine fish and invertebrates accumulate a broad spectrum of aromatic hydrocarbons when exposed to these compounds in water, sediment, or food. In fish, the mode of exposure to aromatic hydrocarbons can markedly influence the extent of accumulation of parent hydrocarbons and their metabolites, as well as the types of metabolites formed. Measurement of enzymatic activity showed that most marine invertebrates and vertebrates were capable of metabolizing aromatic hydrocarbons.

Fish brain appears to accumulate mainly parent aromatic hydrocarbons, such as naphthalene, whereas other sites, such as the liver and bile, contained primarily conjugated and nonconjugated metabolites of aromatic hydrocarbons. The liver enzymes of flatfish converted benzo(a)pyrene into reactive intermediates, such as epoxides, that bound to DNA and proteins. Such interactions are known to damage critical cellular constituents in mammals. Increasing the number of benzenoid rings or the degree of alkyl substitution of aromatic hydrocarbons resulted in increased accumulation of these compounds by fish.

The metabolic profiles of naphthalene in both adult and larval shrimp were similar to those reported for fish. These profiles demonstrated that early developmental stages of shrimp have the enzyme systems necessary to convert naphthalene to both conjugated and nonconjugated metabolites. Exposure to 1-100 ppb of naphthalene in seawater impaired fertilization and early embryonic development of mollusc larvae and survival of crustacea larvae (Malins et al., 1982b).

Low (10-150) ppb concentrations of the SWAF of CICO had deleterious effects upon invertebrates and early life stages of fishes. Shrimp and sea urchin defense responses were reduced by half, and nudibranch molluscs failed to locate mating conspecifics and suffered impaired reproduction and embryological abnormalities. Fish embryos exposed to concentrations of 130 ppb or greater hatched into dead or grossly abnormal larvae.

Regardless of species, vertebrate or invertebrate, mode of exposure or structure of hydrocarbon, the NMFS 1982 study results show that metabolic products are retained in the tissues of marine animals for a longer time than are the parent hydrocarbons from crude oil. These intermediate compounds are highly reactive and may be more toxic than the parent compounds (Malins et al., 1982b).

Biological Differences

The effects of oil pollution on different organisms varies from no effect to responses of avoidance, decreased activity, or physiological stress. Not only do different species react differently, but different lifestages of an organism may show different tolerances to petroleum hydrocarbons. What is toxic to one organism may not be toxic to another, and what is toxic at one time may not be toxic at another. The concentration of hydrocarbons in marine organisms exposed to oil reflects various levels of uptake, metabolism, storage, and discharge. In general, benthic algae, zooplankton, most benthic invertebrates, and fish can depurate hydrocarbons accumulated after exposure to oil. Bivalves, including clams, oysters, and mussels, however, do not possess an enzymatic detoxification system and tend to accumulate hydrocarbons (Lee, 1977).

The bioassay that has been used to determine oil toxicity in the laboratory is the LC_{50} test. The LC_{50} is the concentration causing 50 percent mortality over a given period of time, usually 24, 48, or 96 hours. The toxicity test has limitations due to the number of variables involved, such as the complex mixture of oil, test parameters, and biological factors (lifestage, sex, and contamination history of the organisms). Acute lethal bioassays do provide information on which components of oil are toxic and a basis to compare relative toxicities of oil to species and lifestages. However, laboratory toxicity results often have no relation to oil-spill effects observed in the field. Determination of toxicity thresholds was the first approach used in oil-pollution research. Currently, research at the physiological level is concerned with mechanisms of hydrocarbon toxicity, sites of toxic action and enzymatic detoxification processes. Research at the ecological level is focused on using large field enclosures or mesocosms and flowthrough systems using field concentrations of oil in the laboratory.

Soluble aromatic hydrocarbons can be lethal to adult fishes in low concentrations (1-100 ppm) and to the more sensitive larval stages at even lower concentration (0.1-1 ppm). Crustaceans appear to be the most sensitive (1-10 ppm), while fish and bivalves are moderately sensitive (10-100 ppm); however, lethal concentrations are often lower (0.1-1 ppm) for the more sensitive larval and juvenile forms. Studies cited by

Evans and Rice (1974) show that certain fish eggs are extremely sensitive to the influence of oil products. For example, fertilized eggs of the plaice *(Rhombus macoticus)* were injured at concentrations of 0.01-0.1 ppm with 40-100 percent of the hatched prelarvae perishing, showing signs of degeneration during development (Nounou, 1980).

Table IV-14 contains LC_{50} values for marine organisms indigenous to the Gulf of Mexico, including commercially important species as well as basic components of the food web. Although plants are not usually listed, an LC_{50} value for mangrove propagules (not on the table) is given as $0.5\ l/m^2$ for light Arabian crude oil (Hoi-Chaw and Meow-Chan, 1985). The refined oils, No. 2 fuel oil and Bunker C oil, were more toxic than the crude oils. The WSF's were more toxic than the oil-in-water dispersions (OWD).

Anderson et al. (1974) ranked test species according to increasing sensitivity to oil, from least sensitive to most sensitive as follows: sheepshead minnow, silverside, longnose killifish, brown shrimp (postlarvae), grass shrimp, and mysid. No relationship was found between phylogenetic position or habitat and relative sensitivity to oil. Rabalais et al. (1981) found that eggs and larvae of red drum were very sensitive to *Ixtoc I* oil accommodated in seawater (OAS). Rossi et al. (1976) concluded that the WSF's of the crude oils were less toxic than either No. 2 fuel oil or Bunker C oil. However, the WSF's were more toxic than those obtained from the Anderson et al. (1974) study. This difference was due to the preparation of the WSF by Anderson et al. (1974), which resulted in the loss of toxic, volatile compounds, e.g., benzene and naphthalene. The results obtained by Dillon et al. (1978) indicated that the isopod, *Ligia exotica*, was very tolerant to the WSF and OWD of No. 2 fuel oil; the WSF failed to produce 50 percent mortality. Neff et al. (1976) compared tolerances of lifestages of different species of shrimp to the WSF of No. 2 fuel oil. They found that the juveniles and adults were more sensitive than the larvae in all species, except grass shrimp, which showed the opposite trend.

3. Assumptions and Probabilities of Oil Spill Occurrence and Contact for the Proposed Actions' Analyses

a. Small Spills

Experience shows that small spills occur in the vicinity of pipelines and platforms, and that these spills probably will occur at random during the 39-year life of the proposed action. Also, it is common knowledge that duration or lifespan of an oil spill depends, among other factors, on the initial volume of spilled oil. The former result imposes a restriction on the likelihood that a small spill would contact coastal resources and shorelines, that is, only those small spills close enough to resources or coastlines could make contact. Because of this restriction, it was decided that only those areas close to shorelines could significantly contribute to the number of spills that may contact land. The launch areas contiguous to the Federal-State boundary line satisfy the above restrictions and were used as sources of small spills. The probable number of small spills that could occur from these areas was calculated by multiplying the adequate spill rate by the estimated oil production for each launch area and adding these results. The number of spills in the size class of greater than 1 and less than or equal to 50 bbl calculated to occur for the Base Case and High Case for Sales 131, 135, and 137, and the appropriate planning areas over the expected 39-year life of the proposed action are as follows (numbers are rounded means):

	Base Case	High Case
WPA	10	14
CPA	52	102
EPA	0	6

The probable number of spills in the size class of greater than 50 and less than 1,000 bbl calculated for Sales 131, 135, and 137 for the Base and High Cases and appropriate planning areas over the expected 39-year life of the proposed action are as follows (numbers are rounded means):

Table IV-14

LC_{50} Values for Some Gulf of Mexico Marine Animals

Species	LC_{50} (hours)	Southern Louisiana Crude		Kuwait Crude		No. 2 Fuel Oil		Bunker C Oil		Weathered IXTOC I
		OWD[7] (ppm)	WSF[8] (ppm)	OWD (ppm)	WSF (ppm)	OWD (ppm)	WSF (ppm)	OWD (ppm)	WSF (ppm)	OAS[9] (ppm)
Mysid (*Mysidopsis almyra*)[1]	48	37.5	8.7	63.0	6.6	1.3	0.9	-	0.9	-
Grass shrimp (*Palaemonetes pugio*)[1]	96	200	>16.8	6,000	>10.2	3.0	3.5	-	2.6	-
Brown shrimp postlarvae (*Penaeus aztecus*)[1]	96	>1,000	>19.8	-	-	9.4	4.9	-	1.9	
Sheepshead minnow (*Cyprinodon variegatus*)[1]	96	29,000	>19.8	>80,000	-	93	6.3	-	3.1	
Silverside (*Menidia beryllina*)[1]	96	3,700	5.5	9,400	6.6	-	3.9	-	1.9	-
Longnose killifish (*Fundulus similus*)[1]	96	6,000	16.8	14,800	>10.4	33	3.9	-	1.69	-
Copepods of coastal Texas and laboratory-reared amphipods[2]	96	-	-	-	-	-	-	-	-	>13.5
Red drum eggs and larvae (*Sciaenops ocellata*)[3]	24	-	-	-	-	-	-	-	-	>5.1
Polychaeta (*Capitella capitata*)[4]	96	-	12.0	-	9.8	-	2.3	-	0.9	-
Isopod (*Ligia exotica*)[5]	96	-	-	-	-	36.5	*10	-	-	-
Brown Shrimp (*Penaeus aztecus*)[6]	96									
Postlarvae		-	-	-	-	-	6.6	-	-	-
Early juveniles		-	-	-	-	-	3.7	-	-	-
Late juveniles		-	-	-	-	-	2.9	-	-	-

Table IV-14. LC_{50} Values for Some Gulf of Mexico Marine Animals (continued)

Species	LC_{50} (hours)	Southern Louisiana Crude OWD[7] (ppm)	Southern Louisiana Crude WSF[8] (ppm)	Kuwait Crude OWD (ppm)	Kuwait Crude WSF (ppm)	No. 2 Fuel Oil OWD (ppm)	No. 2 Fuel Oil WSF (ppm)	Bunker C Oil OWD (ppm)	Bunker C Oil WSF (ppm)	Weathered IXTOC I OAS[9] (ppm)
White Shrimp (*Penaeus setiferus*)[6]	96									
Postlarvae		-	-	-	-	-	1.4	-	-	-
Juveniles		-	-	-	-	-	1.0	-	-	-
Grass Shrimp (*Palaemonetes pugio*)[6]	96									
Larvae		-	-	-	-	-	1.2	-	-	-
Postlarvae		-	-	-	-	-	2.4	-	-	-
Adults		-	-	-	-	-	3.5	-	-	-
Opossum Shrimp (*Mysidopsis almyra*)[6]	96									
Postlarvae		-	-	-	-	-	1.75	-	-	-
Adults		-	-	-	-	-	0.65	-	-	-

[1] Anderson et al., 1974.
[2] Lee et al., 1980.
[3] Rabalais et al., 1981.
[4] Rossi et al., 1976.
[5] Dillon et al., 1978.
[6] Neff et al., 1976.
[7] Oil-in-water dispersions.
[8] Water-soluble fraction.
[9] Oil accommodated in seawater.
[10] Failed to produce 50% mortality.

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	Base Case	High Case
WPA	0	1
CPA	2	4
EPA	0	0

Using the above figures, qualitative assumptions regarding the probable numbers of small spills occurring and contacting resources were made to provide a consistent basis for the analysis of the impacts of small spills occurring in the Gulf of Mexico.

For the Base Case in the CPA, it is assumed that a small spill of the size category of greater than 1 and less than or equal to 50 bbl is likely to occur each year, that a low percentage of these spills will occur in proximity to coastal resources, and that a few of the total spills that will occur during the 39-year life of the proposed action will contact the CPA coastline. In the WPA, it is assumed that a small spill of the size category of greater than 1 and less than 50 bbl will occur every 4 years and that about one spill in this size category will contact the WPA coastline during the 39-year life of the proposed action. In the EPA it is assumed that no small spill in this size category will occur and that no resource and/or land segment will be contacted during the 39-year life of the proposed action. For the small-spill category of greater than 50 and less than 1,000 bbl, it is assumed that a few spills of this size will occur in the CPA during the 39-year life of the proposed action but will not contact the coastline or resources. In the WPA and EPA, it is assumed that no spills in this size category will occur and/or contact the resources or shoreline.

For the High Case in the CPA, it is assumed that some spills in the size class of greater than 1 and less than or equal to 50 bbl will occur each year, that a low percentage of these spills will occur in proximity to coastal resources, and that a few of these spills will contact the coastline of the CPA during the 39-year life of the proposed action. For the WPA and EPA it is assumed that a few small spills in this category will occur, that a low percentage of these spills will occur in proximity to coastal resources, and that none of them will contact the coastline of either planning area during the lease life. For the small-spill size class of greater than 50 and less than 1,000 bbl, it is assumed that a few spills will occur in the WPA and CPA during the 39-year life of the proposed action but that none of these spills will contact the coastline of either planning area. In the EPA, it is assumed that no spills in this category will occur or contact a resource or coastline during the 39-year life of the proposed action.

It is assumed that a moderate number (between 30 and 80) of small spills in the size class of greater than 1 and less than or equal to 50 bbl will occur each year in each CPA and WPA analysis area in proximity to coastal environments and that a few of these spills will contact both coastlines each year. For the Total Planning Area Scenario for the EPA, it is assumed that one spill in the size class of greater than 1 and less than or equal to 50 bbl will occur each year, that only a low percentage (less than one per year) of these spills will occur in proximity to coastal resources, and that very few of these spills will contact the coastline during the 39-year life of the proposed action.

For the Total Planning Area for the WPA and CPA, it is assumed that a few spills in the size class of greater than 50 and less than 1,000 bbl will occur each year. None of these spills are assumed to contact the CPA coastline during the 39-year life of the proposed action. For the EPA, it is assumed that no spill will occur and/or contact the resources or coastline during the 39-year life of the proposed action.

It is assumed that spills of one barrel or less will not measurably contribute to the short-term impact of oil spills on sensitive environmental resources. This is because such small spills will weather rapidly, exhibiting an extremely short life as a slick. However, once the oil components are dissipated into the atmosphere and water column, they can contribute to the overall hydrocarbon loadings in the air and water. Impacts from chronic long-term contamination by petroleum hydrocarbons on air and water quality are analyzed in this EIS.

b. Large Spills

As stated in Section IV.C.1.b., the historical database for large spills (greater than or equal to 1,000 bbl) is more complete, and the resulting spill rate has greater reliability. Also, more time has been devoted to their study from all angles because of their dramatic impacts and longer times over the sea surface, among many other factors. As a result, our understanding and experience regarding large spills are considerably more sophisticated than for small spills. Regardless of this emphasis and accumulated knowledge, statistical techniques are used to predict the occurrence of oil spills. For this procedure, it is assumed that spill occurrence can be described as a Poisson process. The parameters of importance become the spill rates (Section IV.C.1.b.) for the different activities of interest, and the estimated production is distributed or aggregated among the different activities. Using this information, the approopriate computations were performed; and the results for the Base and High Cases, Total OCS, and Import Tankering are presented in Table IV-15. This table presents the estimated production, the mean number of spills, and the probability that one or more oil spills will occur over the 39-year life of the proposed action. The tankering values presented in this table represent only that portion of the route covered away from the coastal and port areas. For the major Gulf ports accepting tankered crude oil, the values in Table IV-16 represent the probable spill occurrence in the nearshore/port area itself.

Table IV-16

Tanker Spill Occurrence for Major Ports
Receiving Crude Oil

	Base Case (39 years)		High Case (39 years)		Imports (39 years)	
Port	Mean No.	Prob.	Mean No.	Prob.	Mean No.	Prob.
Corpus Christi, Tex.	--	--	--	--	2.49	0.92
Freeport, Tex.	--	--	--	--	0.83	0.56
Houston, Tex.	--	--	--	--	5.40	0.99+
Port Arthur, Tex.	--	--	--	--	2.49	0.92
Lake Charles, La.	--	--	--	--	2.07	0.87
Miss. River Ports, La.	--	--	--	--	2.07	0.87
LOOP	--	--	--	--	3.11	0.96
Pascagoula, Miss.	--	--	--	--	2.07	0.87
Mobile, Ala.	--	--	--	--	0.21	0.19

Note: -- equals a value of less than 0.005 for both a mean number of spills and a probability.

Source: Hannon and Lear, 1989.

Trajectory Simulation

Oil spill trajectory simulations are conducted using seasonal surface currents coupled with wind data, adjusted every 3 hours for 30 days, until a target is contacted or the trajectory moves off the map. Hypothetical spill trajectories were simulated for each of the potential launch sites across the entire Gulf (Figure IV-8). These simulations presume 500 spills occurring in each of the four seasons of the year. The results are presented as probabilities (expressed as percent chance) that an oil spill starting at a particular launch site will contact a certain land segment within 3, 10, or 30 days. A summary of the trajectory analysis (for 10 days) for all launch sites across the Gulf that present a potential risk to the land segments is given in Table IV-17. This table illustrates that if, for example, an oil spill were to occur in the Western Gulf, the probability (expressed as percent chance) of contact with a certain land segment within 10 days ranges from less than 0.5 percent to 65 percent. The corresponding counties for the highest percent chance of contact are Calhoun County in Texas, Plaquemines Parish in Louisiana, and Escambia County in Florida et al.

Estimated Number of Oil Spills Occurring and Contacting Sensitive Resources

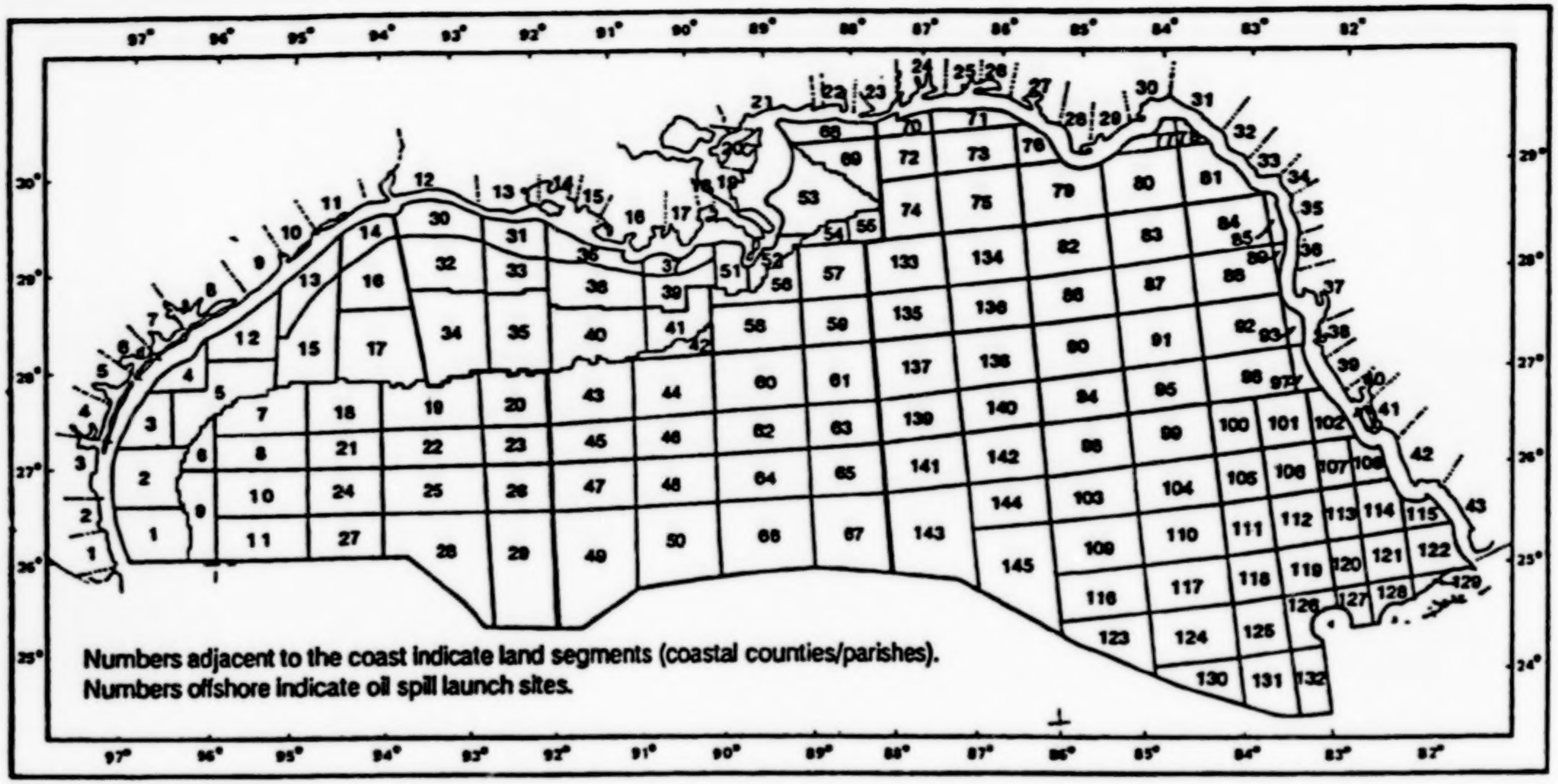
The final phase of the OSRA combines the projected mean number of spill occurrences with the probabilities of contact provided by the trajectory analyses. The results are given in a series of tables presenting two values for each land segment (Table IV-17) and special target across the Gulf, in each of three

Table IV-15

Oil Spill Occurrence Probability Estimates for Spills Greater Than 1,000 Barrels Resulting Over the Expected Production Life of the Proposed Action, High Case, Total Planning Area, and from Imports of Crude Oil by Tanker into the Study Area for Gulf Sales 131/135/137

Source	Volume (Bbl)	Mean Number of Spills from Platforms	Mean Number of Spills from Pipeline	Mean Number of Spills from Tanker	Mean Number of Spills (total)	Probability (% chance) of One or More Spills (platforms)	Probability (% chance) of One or More Spills (pipeline)	Probability (% chance) of One or More Spills (tanker)	Probability (% chance) of One or More Spills (total)
Proposed Action									
Base Case									
Central Gulf	(0.13)	0.08	0.09	0.00	0.17	8	9	0	16
Western Gulf	(0.05)	0.03	0.03	0.01	0.07	3	3	1	7
Eastern Gulf	(0.04)	0.02	0.00	0.03	0.05	2	0	3	5
High Case									
Central Gulf	(0.24)	0.14	0.16	0.00	0.30	13	15	0	26
Western Gulf	(0.11)	0.07	0.06	0.02	0.15	7	6	2	14
Eastern Gulf	(0.09)	0.05	0.01	0.07	0.13	5	1	7	12
Total Planning Area									
Central Gulf	(6.23)	3.74	4.17	0.01	7.92	98	98	1	99+
Western Gulf	(1.25)	0.75	0.75	0.12	1.62	53	53	11	80
Eastern Gulf	(0.37)	0.22	0.02	0.31	0.55	20	2	27	42
Tankering of Crude Oil Imports									
All Planning Areas	(103.67)	-	-	46.65	46.65	-	-	99+	99+

Source: USDI, MMS, Gulf of Mexico OCS Region estimates, 1989.



Numbers adjacent to the coast indicate land segments (coastal counties/parishes).
Numbers offshore indicate oil spill launch sites.

Figure IV-8. Land Segments and Launch Sites Used in the Minerals Management Service Oil Spill Risk Analysis Model.

Table IV-17

Probabilities (expressed as percent chance) that an Oil Spill Starting at a Particular Location Will Contact a Certain Land Segment Within 10 Days for Sales 131/135/137

Hypothetical Spill Locations

Land Segment	W01	W02	W03	W04	W05	W06	W07	W12	W13	W14	W15	W16
1	14	1	n	n	n	n	n	n	n	n	n	n
2	5	2	n	n	n	n	n	n	n	n	n	n
3	7	17	2	n	n	n	n	n	n	n	n	n
4	1	13	8	n	n	n	n	n	n	n	n	n
5	n	5	17	1	n	n	n	n	n	n	n	n
6	n	2	22	4	1	n	n	n	n	n	n	n
7	n	n	12	41	8	2	n	1	n	n	n	n
8	n	n	n	23	7	n	1	38	1	n	n	n
9	n	n	n	n	n	n	n	9	12	n	1	n
10	n	n	n	n	n	n	n	n	26	11	1	1
11	n	n	n	n	n	n	n	n	n	17	n	1
12	n	n	n	n	n	n	n	n	n	4	n	n

Land Segment	C30	C31	C32	C33	C36	C37	C38	C39	C41
11	2	n	n	n	n	n	n	n	n
12	43	2	2	n	n	n	n	n	n
13	2	26	n	1	1	n	n	n	n
14	n	7	n	n	5	n	n	n	n
15	n	1	n	n	11	n	n	n	n
16	n	n	n	n	27	15	3	3	n
17	n	n	n	n	n	21	n	5	1
18	n	n	n	n	n	7	n	1	n
19	n	n	n	n	n	1	n	n	n

Table IV-17. Probabilities (expressed as percent chance) that an Oil Spill Starting at a Particular Location Will Contact a Certain Land Segment Within 10 Days for Sales 131/135/137 (continued)

Land Segment	C51	C52	C53	C54	C56	C57	C58	C59	C60	C68	C69	E70	E71	E72	E73
17	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n
18	7	n	n	n	n	n	n	n	n	n	n	n	n	n	n
19	35	65	32	5	29	1	12	1	2	n	1	n	n	n	n
20	n	n	9	1	n	n	n	n	n	4	2	n	n	n	n
21	n	n	n	n	n	n	n	n	n	23	4	n	n	n	n
22	n	n	n	n	n	n	n	n	n	18	5	1	n	n	n
23	n	n	n	n	n	n	n	n	n	10	3	16	n	3	n
24	n	n	n	n	n	n	n	n	n	n	n	25	7	3	n
25	n	n	n	n	n	n	n	n	n	n	n	1	11	n	1
26	n	n	n	n	n	n	n	n	n	n	n	n	10	n	1
27	n	n	n	n	n	n	n	n	n	n	n	n	5	n	2

Land Segment	E76	E77	E78	E79	E80	E81	E85	E89	E93	E97
27	9	n	n	n	n	n	n	n	n	n
28	6	n	n	1	n	n	n	n	n	n
29	2	22	2	3	3	n	n	n	n	n
30	n	11	10	n	n	n	n	n	n	n
31	n	1	17	n	n	1	n	n	n	n
32	n	n	4	n	n	5	n	n	n	n
33	n	n	n	n	n	2	4	n	n	n
34	n	n	n	n	n	n	6	n	n	n
35	n	n	n	n	n	n	5	1	n	n
36	n	n	n	n	n	n	1	5	n	n
37	n	n	n	n	n	n	n	3	8	n
38	n	n	n	n	n	n	n	n	1	1
39	n	n	n	n	n	n	n	n	n	3

Table IV-17. Probabilities (expressed as percent chance) that an Oil Spill Starting at a Particular Location Will Contact a Certain Land Segment Within 10 Days for Sales 131/135/137 (continued)

Land Segment	E102	E108	E114	E115	E122
39	2	n	n	n	n
40	1	n	n	n	n
41	1	6	n	n	n
42	n	1	1	5	n
43	n	n	n	1	1

Notes: n = less than 0.5%. Rows with all values less than 0.5% are not shown.

Source: Hannon and Lear, 1989.

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time increments; 3, 10, and 30 days. The two values represent (1) the probability of one or more spills occurring and contacting the target and (2) the estimated mean number of spills that might occur and contact the target. Tables IV-18, IV-19, and IV-20 are subsets of these tables and show only those land segments and special targets considered most at risk of contact by an oil spill resulting from Gulfwide development, production, or transportation and reaching these targets within 10 days. In many areas around the Gulf, several sensitive resources occur within the same geographic limits. For the sake of efficiency in running the model, most of these areas were submitted only once, with the results being renamed or combined to represent other resources in the same area. Following is a list of the targets submitted for the OSRA. These targets were also used by the Leasing and Environment staff in the Gulf of Mexico OCS Region to define a second set of resources in the same area.

The results from:	Also represent:
Timbalier Bay	Timbalier Bay Seagrass Beds Isle Dernier/Timbalier Island Coastal Barrier
Chandeleur/Breton Coastal Barrier	Chandeleur Sound Seagrass Beds Chandeleur/Breton Sound
Upper Keys, Lower Keys, and Florida Bay Seagrass Beds	Keys Brown Pelican Nesting/Foraging
Mississippi Sound	Gulf Islands National Seashore Rec. Beaches
West Plaquemines Coastal Barrier and Land Segments 14, 15, 16, 17, and 18	West Deltaic Plains Marshes
Upper Florida Keys	Upper Keys Mangroves Upper Keys Seagrass Beds Upper Keys Coral Reefs
Lower Florida Keys	Lower Keys Mangroves Lower Keys Seagrass Beds Lower Keys Coral Reefs
Land Segment 43 Upper Florida Keys Lower Florida Keys	Monroe County Tourism
Land Segment 21	Hancock County, Miss., Pelican Habitat
Land Segment 22	Mobile County, Ala., Pelican Habitat

The following recreational beach targets were combined to give statewide recreational beach values:

Texas Rec. Beaches	Brazos/South Padre Is. Rec. Beaches Padre Is. National Seashore/Mustang Is. Rec. Beaches Matagorda Is. Rec. Beaches Matagorda County Rec. Beaches Brazoria County Rec. Beaches Galveston Is./Bolivar Peninsula Rec. Beaches Sea Rim Rec. Beaches

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Table IV-18

Probabilities (expressed as percent chance) of One or More Spills and the Estimated Number of Spills (mean) Occurring and Contacting Land Segments Over the Expected Production Life of the Lease Area Within 10 Days (Central Gulf Sale 131)

Land Segment/ Environmental Resource	Base Case (Central)		High Case (Central)		Total Planning Area (Central)		Imports		Aggregate (Gulfwide)	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
1 - Cameron, TX	-	-	-	-	-	-	-	-	-	-
2 - Willacy, TX	-	-	-	-	-	-	-	-	-	-
3 - Kenedy, TX	-	-	-	-	-	-	-	-	-	-
4 - Kleberg, TX	-	-	-	-	-	-	1	*	1	*
5 - Nueces, TX et al.	-	-	-	-	-	-	6	0.1	8	0.1
6 - Aransas, TX	-	-	-	-	-	-	12	0.1	14	0.2
7 - Calhoun, TX	-	-	-	-	-	-	8	0.1	11	0.1
8 - Matagorda, TX	-	-	-	-	-	-	-	-	1	*
9 - Brazoria, TX	-	-	-	-	-	-	5	*	5	0.1
10 - Galveston, TX et al.	-	-	-	-	-	-	31	0.4	37	0.5
11 - Jefferson, TX	-	-	-	-	-	-	9	0.1	9	0.1
12 - Cameron, LA	-	-	-	-	8	0.1	21	0.2	27	0.3
13 - Vermilion, LA	-	-	-	-	8	0.1	-	-	8	0.1
14 - New Iberia, LA	-	-	-	-	9	0.1	-	-	9	0.1
15 - St. Mary, LA	-	-	-	-	13	0.1	-	-	13	0.1
16 - Terrebonne, LA	1	*	1	*	33	0.4	-	-	33	0.4
17 - Lafourche, LA	-	-	-	-	15	0.2	2	*	16	0.2
18 - Jefferson, LA	-	-	-	-	13	0.1	1	*	14	0.1
19 - Plaquemines, LA	1	*	1	*	58	0.9	31	0.4	71	1.2
20 - St. Bernard, LA et al.	-	-	-	-	2	*	1	*	3	*
21 - Hancock, MS et al.	-	-	-	-	3	*	13	0.1	16	0.2
22 - Mobile, AL	-	-	-	-	1	*	4	*	6	0.1
23 - Baldwin, AL	-	-	-	-	-	-	1	*	1	*
44 - Dade, FL	-	-	-	-	-	-	19	0.2	19	0.2
45 - Broward, FL	-	-	-	-	-	-	2	*	2	*
Land	2	*	3	*	87	2.0	85	1.9	98	4.1
Western Deepwater Boundary	-	-	-	-	3	*	83	1.8	88	2.1
Whooping Crane Foraging	-	-	-	-	-	-	4	*	7	0.1
Corpus Christi Brown Pelican Nest/Forage	-	-	-	-	-	-	24	0.3	28	0.3
Western Sea Turtle Nesting	-	-	-	-	-	-	5	0.1	6	0.1
Western Sea Turtle Foraging	-	-	-	-	-	-	37	0.5	43	0.6
Central Deepwater Boundary	4	*	8	0.1	61	0.9	96	3.2	98	4.2
Timbalier Bay	1	*	1	*	31	0.4	1	*	32	0.4
Barataria Bay	-	-	1	*	48	0.7	9	0.1	53	0.7
Barataria Brown Pelican Nest/Forage	-	-	1	*	41	0.5	8	0.1	46	0.6
Chandeleur Brown Pelican Nest/Forage	-	-	-	-	6	0.1	10	0.1	16	0.2

Table IV-18. Probabilities (expressed as percent chance) of One or More Spills and the Estimated Number of Spills (mean) Occurring and Contacting Land Segments Over the Expected Production Life of the Lease Area Within 10 Days (Central Gulf Sale 131) (continued)

Land Segment/ Environmental Resource	Base Case (Central)		High Case (Central)		Total Planning Area (Central)		Imports		Aggregate (Gulfwide)	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
Hancock County, MS, Pelican Habitat	-	-	-	-	-	-	-	-	16	0.2
Mobile County, AL, Pelican Habitat	-	-	-	-	-	-	-	-	6	0.1
Central Sea Turtle Nesting	-	-	-	-	4	*	10	0.1	14	0.1
Central Sea Turtle Foraging	2	*	3	*	69	1.2	7	0.1	71	1.2
Mississippi Sound	-	-	-	-	6	0.1	16	0.2	21	0.2
Caminada Headland Coastal Barrier	-	-	-	-	28	0.3	5	0.1	32	0.4
West Plaquemines Coastal Barrier	-	-	1	*	60	0.9	38	0.5	76	1.4
Chandeleur/Breton Coastal Barrier	-	-	-	-	13	0.1	10	0.1	21	0.2
East Deltaic Plain Marshes	1	*	1	*	51	0.7	24	0.3	63	1.0
W. Winter Menhaden Spawning Ground	1	*	1	*	38	0.5	-	-	39	0.5
C. Winter Menhaden Spawning Ground	-	-	-	-	38	0.5	21	0.2	51	0.7
E. Winter Menhaden Spawning Ground	-	-	-	-	27	0.3	27	0.3	47	0.6
Eastern Deepwater Boundary	-	-	-	-	3	*	65	1.1	69	1.2
N. Florida Sea Turtle Nest/Forage	-	-	-	-	-	-	-	-	1	*
C. Florida Sea Turtle Nest/Forage	-	-	-	-	-	-	-	-	1	*
S. Florida Sea Turtle Nest/Forage	-	-	-	-	-	-	16	0.2	16	0.2
Florida Bay Seagrass Beds	-	-	-	-	-	-	1	*	1	*
Dry Tortugas	-	-	-	-	-	-	16	0.2	17	0.2
Upper Florida Keys	-	-	-	-	-	-	10	0.1	10	0.1
Lower Florida Keys	-	-	-	-	-	-	10	0.1	10	0.1
North Padre Island Coastal Barrier	-	-	-	-	-	-	1	*	2	*
Mustang Island Coastal Barrier	-	-	-	-	-	-	6	0.1	8	0.1
St. Joseph Island Coastal Barrier	-	-	-	-	-	-	12	0.1	14	0.2
Matagorda Island Coastal Barrier	-	-	-	-	-	-	8	0.1	11	0.1
Matagorda Peninsula Coastal Barrier	-	-	-	-	-	-	-	-	1	*
Brazos Headland Coastal Barrier	-	-	-	-	-	-	5	*	5	0.1
Galveston Is./Bolivar Peninsula Coastal Barrier	-	-	-	-	-	-	31	0.4	37	0.5
Rollover Pass to Sabine Pass Coastal Barrier	-	-	-	-	-	-	9	0.1	9	0.1
Laguna Madre Seagrass Beds	-	-	-	-	-	-	1	*	2	*
Corpus Christi Bay Seagrass Beds	-	-	-	-	-	-	6	0.1	8	0.1
Espiritu Santo/Matagorda Seagrass Beds	-	-	-	-	-	-	8	0.1	12	0.1
Galveston Seagrass Beds	-	-	-	-	-	-	31	0.4	37	0.5
Espiritu Santo/Matagorda Bays	-		-	-	-	-	8	0.1	12	0.1
Galveston Bay	-		-	-	-	-	31	0.4	37	0.5

Table IV-18. Probabilities (expressed as percent chance) of One or More Spills and the Estimated Number of Spills (mean) Occurring and Contacting Land Segments Over the Expected Production Life of the Lease Area Within 10 Days (Central Gulf Sale 131) (continued)

Land Segment/ Environmental Resource	Base Case (Central)		High Case (Central)		Total Planning Area (Central)		Imports		Aggregate (Gulfwide)	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
Texas Coastal Marshes - Central	-	-	-	-	-	-	19	0.2	25	0.3
Texas Coastal Marshes - Eastern	-	-	-	-	-	-	40	0.5	46	0.6
Padre Is. Nat. Seashore/Mustang Is. Rec. Beaches	-	-	-	-	-	-	7	0.1	9	0.1
Matagorda Island Rec. Beaches	-	-	-	-	-	-	8	0.1	11	0.1
Matagorda County Rec. Beaches	-	-	-	-	-	-	-	-	1	*
Brazoria County Rec. Beaches	-	-	-	-	-	-	5	*	5	0.1
Galveston Is./Bolivar Peninsula Rec. Beaches	-	-	-	-	-	-	31	0.4	37	0.5
Sea Rim Rec. Beaches	-	-	-	-	-	-	9	0.1	9	0.1
Texas Rec. Beaches	-	-	-	-	-	-	-	-	56	0.9
Chenier Plain Coastal Barrier	-	-	-	-	15	0.2	21	0.2	32	0.4
Grand Isle/Grand Terre Coastal Barrier	-	-	-	-	13	0.1	1	*	14	0.1
Dauphin Island Coastal Barrier	-	-	-	-	1	*	4	*	6	0.1
Gulf Shores Coastal Barrier	-	-	-	-	-	-	1	*	1	*
Mobile Bay/Perdido Bay Seagrass Beds	-	-	-	-	1	*	5	*	7	0.1
Vermilion/Atchafalaya Bays	-	-	-	-	20	0.2	-	-	21	0.2
Mobile Bay	-	-	-	-	1	*	5	*	7	0.1
Chenier Plain Marshes	-	-	-	-	15	0.2	21	0.2	32	0.4
West Deltaic Plains Marshes	1	*	2	*	-	-	-	-	91	2.4
Cameron Parish Rec. Beaches	-	-	-	-	8	0.1	21	0.2	27	0.3
Fourchon Rec. Beaches	-	-	-	-	15	0.2	2	*	16	0.2
Grand Isle Rec. Beaches	-	-	-	-	13	0.1	1	*	14	0.1
Louisiana Rec. Beaches	-	-	-	-	-	-	-	-	47	0.6
Mississippi Mainland Rec. Beaches	-	-	-	-	3	*	13	0.1	16	0.2
Mississippi Rec. Beaches	-	-	-	-	-	-	-	-	34	0.4
Dauphin Island Rec. Beaches	-	-	-	-	1	*	4	*	6	0.1
Gulf Shores Rec. Beaches	-	-	-	-	-	-	1	*	1	*
Alabama Rec. Beaches	-	-	-	-	-	-	-	-	7	0.1
Emerald Coast Coastal Barrier	-	-	-	-	-	-	-	-	1	*
Emerald Coast Rec. Beaches	-	-	-	-	-	-	-	-	1	*
Florida Rec. Beaches	-	-	-	-	-	-	-	-	1	*
Keys Brown Pelican Nest/Forage	-	-	-	-	-	-	-	-	20	0.2
Everglades Manatee	-	-	-	-	-	-	19	0.2	19	0.2
Everglades Mangroves	-	-	-	-	-	-	19	0.2	19	0.2

Note: - = less than 0.5%; * = 0.0%. Segments with less than 0.5% probability of one or more contacts within 10 days are not shown.

Source: Hannon and Lear, 1989.

Table IV-19

Probabilities (expressed as percent chance) of One or More Spills and the Estimated Number of Spills (mean) Occurring and Contacting Land Segments Over the Expected Production Life of the Lease Area Within 10 Days (Western Gulf Sale 135)

Land Segment/ Environmental Resource	Base Case (Western) Prob	Base Case (Western) Mean	High Case (Western) Prob	High Case (Western) Mean	Total Planning Area (Western) Prob	Total Planning Area (Western) Mean	Imports Prob	Imports Mean	Aggregate (Gulfwide) Prob	Aggregate (Gulfwide) Mean
4 - Kleberg, TX	-	-	-	-	-	-	1	*	1	*
5 - Nueces, TX et al.	-	-	-	-	2	*	6	0.1	8	0.1
6 - Aransas, TX	-	-	-	-	2	*	12	0.1	14	0.2
7 - Calhoun, TX	-	-	-	-	4	*	8	0.1	11	0.1
8 - Matagorda, TX	-	-	-	-	1	*	-	-	1	*
9 - Brazoria, TX	-	-	-	-	1	*	5	*	5	0.1
10 - Galveston, TX et al.	-	-	-	-	8	0.1	31	0.4	37	0.5
11 - Jefferson, TX	-	-	-	-	1	*	9	0.1	9	0.1
12 - Cameron, LA	-	-	-	-	-	-	21	0.2	27	0.3
13 - Vermilion, LA	-	-	-	-	-	-	-	-	8	0.1
14 - New Iberia, LA	-	-	-	-	-	-	-	-	9	0.1
15 - St. Mary, LA	-	-	-	-	-	-	-	-	13	0.1
16 - Terrebonne, LA	-	-	-	-	-	-	-	-	33	0.4
17 - Lafourche, LA	-	-	-	-	2	*	-	-	16	0.2
18 - Jefferson, LA	-	-	-	-	1	*	-	-	14	0.1
19 - Plaquemines, LA	-	-	-	-	31	0.4	-	-	71	1.2
20 - St. Bernard, LA et al	-	-	-	-	1	*	-	-	3	*
21 - Hancock, MS et al.	-	-	-	-	13	0.1	-	-	16	0.2
22 - Mobile, AL	-	-	-	-	4	*	-	-	6	0.1
23 - Baldwin, AL	-	-	-	-	1	*	-	-	1	*
44 - Dade, FL	-	-	-	-	19	0.2	-	-	19	0.2
45 - Broward, FL	-	-	-	-	2	*	-	-	2	*
Land	1	*	1	*	18	0.2	85	1.9	98	4.1
Western Deepwater Boundary	2	*	4	*	29	0.3	83	1.8	88	2.1
Whooping Crane Foraging	-	-	-	-	2	*	4	*	7	0.1
Corpus Christi Brown Pelican Nest/Forage	-	-	1	*	6	0.1	24	0.3	28	0.3
Western Sea Turtle Nesting	-	-	-	-	1	*	5	0.1	6	0.1
Western Sea Turtle Foraging	-	-	1	*	9	0.1	37	0.5	43	0.6
Central Deepwater Boundary	-	-	-	-	-	-	96	3.2	98	4.2
Timbalier Bay	-	-	-	-	-	-	1	*	32	0.4
Barataria Bay	-	-	-	-	-	-	9	0.1	53	0.7
Barataria Brown Pelican Nest/Forage	-	-	-	-	-	-	8	0.1	46	0.6
Chandeleur Brown Pelican Nest/Forage	-	-	-	-	-	-	10	0.1	16	0.2

Table IV-19. Probabilities (expressed as percent chance) of One or More Spills and the Estimated Number of Spills (mean) Occurring and Contacting Land Segments Over the Expected Production Life of the Lease Area Within 10 Days (Western Gulf Sale 135) (continued)

Land Segment/ Environmental Resource	Base Case (Western)		High Case (Western)		Total Planning Area (Western)		Imports		Aggregate (Gulfwide)	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
Hancock County, MS, Pelican Habitat	-	-	-	-	-	-	-	-	16	0.2
Mobile County, AL, Pelican Habitat	-	-	-	-	-	-	-	-	6	0.1
Central Sea Turtle Nesting	-	-	-	-	-	-	10	0.1	14	0.1
Central Sea Turtle Foraging	-	-	-	-	1	*	7	0.1	71	1.2
Mississippi Sound	-	-	-	-	-	-	16	0.2	21	0.2
Caminada Headland Coastal Barrier	-	-	-	-	-	-	5	0.1	32	0.4
West Plaquemines Coastal Barrier	-	-	-	-	-	-	38	0.5	76	1.4
Chandeleur/Breton Coastal Barrier	-	-	-	-	-	-	10	0.1	21	0.2
East Deltaic Plain Marshes	-	-	-	-	-	-	24	0.3	63	1.0
W. Winter Menhaden Spawning Ground	-	-	-	-	1	*	-	-	39	0.5
C. Winter Menhaden Spawning Ground	-	-	-	-	-	-	21	0.2	51	0.7
E. Winter Menhaden Spawning Ground	-	-	-	-	-	-	27	0.3	47	0.6
Eastern Deepwater Boundary	-	-	-	-	-	-	65	1.1	69	1.2
N. Florida Sea Turtle Nest/Forage	-	-	-	-	-	-	-	-	1	*
C. Florida Sea Turtle Nest/Forage	-	-	-	-	-	-	-	-	1	*
S. Florida Sea Turtle Nest/Forage	-	-	-	-	-	-	16	0.2	16	0.2
Florida Bay Seagrass Beds	-	-	-	-	-	-	1	*	1	*
Dry Tortugas	-	-	-	-	-	-	16	0.2	17	0.2
Upper Florida Keys	-	-	-	-	-	-	10	0.1	10	0.1
Lower Florida Keys	-	-	-	-	-	-	10	0.1	10	0.1
North Padre Island Coastal Barrier	-	-	-	-	-	-	1	*	2	*
Mustang Island Coastal Barrier	-	-	-	-	2	*	6	0.1	8	0.1
St. Joseph Island Coastal Barrier	-	-	-	-	2	*	12	0.1	14	0.2
Matagorda Island Coastal Barrier	-	-	-	-	4	*	8	0.1	11	0.1
Matagorda Peninsula Coastal Barrier	-	-	-	-	1	*	-	-	1	*
Brazos Headland Coastal Barrier	-	-	-	-	1	*	5	*	5	0.1
Galveston Is./Bolivar Peninsula Coastal Barrier	-	-	-	-	8	0.1	31	0.4	37	0.5
Rollover Pass to Sabine Pass Coastal Barrier	-	-	-	-	1	*	9	0.1	9	0.1
Laguna Madre Seagrass Beds	-	-	-	-	-	-	1	*	2	*
Corpus Christi Bay Seagrass Beds	-	-	-	-	2	*	6	0.1	8	0.1
Espiritu Santo/Matagorda Seagrass Beds	-	-	-	-	5	*	8	0.1	12	0.1
Galveston Seagrass Beds	-	-	-	-	8	0.1	31	0.4	37	0.5
Espiritu Santo/Matagorda Bays	-	-	-	-	5	*	8	0.1	12	0.1
Galveston Bay	-	-	-	-	8	0.1	31	0.4	37	0.5

Table IV-19. Probabilities (expressed as percent chance) of One or More Spills and the Estimated Number of Spills (mean) Occurring and Contacting Land Segments Over the Expected Production Life of the Lease Area Within 10 Days (Western Gulf Sale 135) (continued)

Land Segment/ Environmental Resource	Base Case (Western) Prob	Base Case (Western) Mean	High Case (Western) Prob	High Case (Western) Mean	Total Planning Area (Western) Prob	Total Planning Area (Western) Mean	Imports Prob	Imports Mean	Aggregate (Gulfwide) Prob	Aggregate (Gulfwide) Mean
Texas Coastal Marshes - Central	-	-	-	-	7	0.1	19	0.2	25	0.3
Texas Coastal Marshes - Eastern	-	-	1	*	10	0.1	40	0.5	46	0.6
Padre Is. Nat. Seashore/Mustang Is. Rec. Beaches	-	-	-	-	2	*	7	0.1	9	0.1
Matagorda Island Rec. Beaches	-	-	-	-	4	*	8	0.1	11	0.1
Matagorda County Rec. Beaches	-	-	-	-	1	*	-	-	1	*
Brazoria County Rec. Beaches	-	-	-	-	1	*	5	*	5	0.1
Galveston Is./Bolivar Peninsula Rec. Beaches	-	-	-	-	8	0.1	31	0.4	37	0.5
Sea Rim Rec. Beaches	-	-	-	-	1	*	9	0.1	9	0.1
Texas Rec. Beaches	-	-	-	-	-	-	-	-	56	0.9
Chenier Plain Coastal Barrier	-	-	-	-	-	-	21	0.2	32	0.4
Grand Isle/Grand Terre Coastal Barrier	-	-	-	-	-	-	1	*	14	0.1
Dauphin Island Coastal Barrier	-	-	-	-	-	-	4	*	6	0.1
Gulf Shores Coastal Barrier	-	-	-	-	-	-	1	*	1	*
Mobile Bay/Perdido Bay Seagrass Beds	-	-	-	-	-	-	5	*	7	0.1
Vermilion/Atchafalaya Bays	-	-	-	-	-	-	-	-	21	0.2
Mobile Bay	-	-	-	-	-	-	5	*	7	0.1
Chenier Plain Marshes	-	-	-	-	-	-	21	0.2	32	0.4
West Deltaic Plains Marshes	-	-	-	-	-	-	-	-	91	2.4
Cameron Parish Rec. Beaches	-	-	-	-	-	-	21	0.2	27	0.3
Fourchon Rec. Beaches	-	-	-	-	-	-	2	*	16	0.2
Grand Isle Rec. Beaches	-	-	-	-	-	-	1	*	14	0.1
Louisiana Rec. Beaches	-	-	-	-	-	-	-	-	47	0.6
Mississippi Mainland Rec. Beaches	-	-	-	-	-	-	13	0.1	16	0.2
Mississippi Rec. Beaches	-	-	-	-	-	-	-	-	34	0.4
Dauphin Island Rec. Beaches	-	-	-	-	-	-	4	*	6	0.1
Gulf Shores Rec. Beaches	-	-	-	-	-	-	1	*	1	*
Alabama Rec. Beaches	-	-	-	-	-	-	-	-	7	0.1
Emerald Coast Coastal Barrier	-	-	-	-	-	-	-	-	1	*
Emerald Coast Rec. Beaches	-	-	-	-	-	-	-	-	1	*
Florida Rec. Beaches	-	-	-	-	-	-	-	-	1	*
Keys Brown Pelican Nest/Forage	-	-	-	-	-	-	-	-	20	0.2
Everglades Manatee	-	-	-	-	-	-	19	0.2	19	0.2
Everglades Mangroves	-	-	-	-	-	-	19	0.2	19	0.2

Note: - = less than 0.5%; * = 0.0%. Segments with less than 0.5% probability of one or more contacts within 10 days are not shown.

Source: Hannon and Lear, 1989.

Table IV-20

Probabilities (expressed as percent chance) of One or More Spills and the Estimated Number of Spills (mean) Occurring and Contacting Land Segments Over the Expected Production Life of the Lease Area Within 10 Days (Eastern Gulf Sale 137)

Land Segment/ Environmental Resource	Base Case (Eastern)		High Case (Eastern)		Total Planning Area (Eastern)		Imports		Aggregate (Gulfwide)	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
4 - Kleberg, TX	-	-	-	-	-	-	1	•	1	•
5 - Nueces, TX et al.	-	-	-	-	-	-	6	0.1	8	0.1
6 - Aransas, TX	-	-	-	-	-	-	12	0.1	14	0.2
7 - Calhoun, TX	-	-	-	-	-	-	8	0.1	11	0.1
8 - Matagorda, TX	-	-	-	-	-	-	-	-	1	•
9 - Brazoria, TX	-	-	-	-	-	-	5	•	5	0.1
10 - Galveston, TX et al.	-	-	-	-	-	-	31	0.4	37	0.5
11 - Jefferson, TX	-	-	-	-	-	-	9	0.1	9	0.1
12 - Cameron, LA	-	-	-	-	-	-	21	0.2	27	0.3
13 - Vermilion, LA	-	-	-	-	-	-	-	-	8	0.1
14 - New Iberia, LA	-	-	-	-	-	-	-	-	9	0.1
15 - St. Mary, LA	-	-	-	-	-	-	-	-	13	0.1
16 - Terrebonne, LA	-	-	-	-	-	-	-	-	33	0.4
17 - Lafourche, LA	-	-	-	-	-	-	2	•	16	0.2
18 - Jefferson, LA	-	-	-	-	-	-	1	•	14	0.1
19 - Plaquemines, LA	-	-	-	-	2	•	31	0.4	71	1.2
20 - St. Bernard, LA et al.	-	-	-	-	-	-	1	•	3	•
21 - Hancock, MS et al.	-	-	-	-	-	-	13	0.1	16	0.2
22 - Mobile, AL	-	-	-	-	-	-	4	•	6	0.1
23 - Baldwin, AL	-	-	-	-	-	-	1	•	1	•
44 - Dade, FL	-	-	-	-	-	-	19	0.2	19	0.2
45 - Broward, FL	-	-	-	-	-	-	2	•	2	•
Land	1	•	1	•	3	•	85	1.9	98	4.1
Western Deepwater Boundary	-	-	-	-	-	-	83	1.8	88	2.1
Whooping Crane Foraging	-	-	-	-	-	-	4	•	7	0.1
Corpus Christi Brown Pelican Nest/Forage	-	-	-	-	-	-	24	0.3	28	0.3
Western Sea Turtle Nesting	-	-	-	-	-	-	5	0.1	6	0.1
Western Sea Turtle Foraging	-	-	-	-	-	-	37	0.5	43	0.6
Central Deepwater Boundary	-	-	-	-	2	•	96	3.2	98	4.2
Timbalier Bay	-	-	-	-	-	-	1	•	32	0.4
Barataria Bay	-	-	-	-	-	-	9	0.1	53	0.7
Barataria Brown Pelican Nest/Forage	-	-	-	-	-	-	8	0.1	46	0.6
Chandeleur Brown Pelican Nest/Forage	-	-	-	-	-	-	10	0.1	16	0.2

Table IV-20. Probabilities (expressed as percent chance) of One or More Spills and the Estimated Number of Spills (mean) Occurring and Contacting Land Segments Over the Expected Production Life of the Lease Area Within 10 Days (Eastern Gulf Sale 137) (continued)

Land Segment/ Environmental Resource	Base Case (Eastern)		High Case (Eastern)		Total Planning Area (Eastern)		Imports		Aggregate (Gulfwide)	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
Hancock County, MS, Pelican Habitat	-	-	-	-	-	-	-	-	16	0.2
Mobile County, AL, Pelican Habitat	-	-	-	-	-	-	-	-	6	0.1
Central Sea Turtle Nesting	-	-	-	-	-	-	10	0.1	14	0.1
Central Sea Turtle Foraging	-	-	-	-	-	-	7	0.1	71	1.2
Mississippi Sound	-	-	-	-	-	-	16	0.2	21	0.2
Caminada Headland Coastal Barrier	-	-	-	-	-	-	5	0.1	32	0.4
West Plaquemines Coastal Barrier	-	-	-	-	2	•	38	0.5	76	1.4
Chandeleur/Breton Coastal Barrier	-	-	-	-	-	-	10	0.1	21	0.2
East Deltaic Plain Marshes	-	-	-	-	1	•	24	0.3	63	1.0
W. Winter Menhaden Spawning Ground	-	-	-	-	-	-	-	-	39	0.5
C. Winter Menhaden Spawning Ground	-	-	-	-	-	-	21	0.2	51	0.7
E. Winter Menhaden Spawning Ground	-	-	-	-	1	•	27	0.3	47	0.6
Eastern Deepwater Boundary	1	•	2	•	70	.1	65	1.1	69	1.2
N. Florida Sea Turtle Nest/Forage	-	-	1	•	1	•	-	-	1	•
C. Florida Sea Turtle Nest/Forage	-	-	-	-	1	•	-	-	1	•
S. Florida Sea Turtle Nest/Forage	-	-	-	-	-	-	16	0.2	16	0.2
Florida Bay Seagrass Beds	-	-	-	-	-	-	1	•	1	•
Dry Tortugas	-	-	-	-	1	•	16	0.2	17	0.2
Upper Florida Keys	-	-	-	-	-	-	10	0.1	10	0.1
Lower Florida Keys	-	-	-	-	-	-	10	0.1	10	0.1
North Padre Island Coastal Barrier	-	-	-	-	-	-	1	•	2	•
Mustang Island Coastal Barrier	-	-	-	-	-	-	6	0.1	8	0.1
St. Joseph Island Coastal Barrier	-	-	-	-	-	-	12	0.1	14	0.2
Matagorda Island Coastal Barrier	-	-	-	-	-	-	8	0.1	11	0.1
Matagorda Peninsula Coastal Barrier	-	-	-	-	-	-	-	-	1	•
Brazos Headland Coastal Barrier	-	-	-	-	-	-	5	•	5	0.1
Galveston Is./Bolivar Peninsula Coastal Barrier	-	-	-	-	-	-	31	0.4	37	0.5
Rollover Pass to Sabine Pass Coastal Barrier	-	-	-	-	-	-	9	0.1	9	0.1
Laguna Madre Seagrass Beds	-	-	-	-	-	-	1	•	2	•
Corpus Christi Bay Seagrass Beds	-	-	-	-	-	-	6	0.1	8	0.1
Espiritu Santo/Matagorda Seagrass Beds	-	-	-	-	-	-	8	0.1	12	0.1
Galveston Seagrass Beds	-	-	-	-	-	-	31	0.4	37	0.5
Espiritu Santo/Matagorda Bays	-	-	-	-	-	-	8	0.1	12	0.1
Galveston Bay	-	-	-	-	-	-	31	0.4	37	0.5

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Table IV-20. Probabilities (expressed as percent chance) of One or More Spills and the Estimated Number of Spills (mean) Occurring and Contacting Land Segments Over the Expected Production Life of the Lease Area Within 10 Days (Eastern Gulf Sale 137) (continued)

Land Segment/ Environmental Resource	Base Case (Eastern) Prob	Base Case (Eastern) Mean	High Case (Eastern) Prob	High Case (Eastern) Mean	Total Planning Area (Eastern) Prob	Total Planning Area (Eastern) Mean	Imports Prob	Imports Mean	Aggregate (Gulfwide) Prob	Aggregate (Gulfwide) Mean
Texas Coastal Marshes - Central	-	-	-	-	-	-	19	0.2	25	0.3
Texas Coastal Marshes - Eastern	-	-	-	-	-	-	40	0.5	46	0.6
Padre Is. Nat. Seashore/Mustang Is. Rec. Beaches	-	-	-	-	-	-	7	0.1	9	0.1
Matagorda Island Rec. Beaches	-	-	-	-	-	-	8	0.1	11	0.1
Matagorda County Rec. Beaches	-	-	-	-	-	-	-	-	1	*
Brazoria County Rec. Beaches	-	-	-	-	-	-	5	*	5	0.1
Galveston Is./Bolivar Peninsula Rec. Beaches	-	-	-	-	-	-	31	0.4	37	0.5
Sea Rim Rec. Beaches	-	-	-	-	-	-	9	0.1	9	0.1
Texas Rec. Beaches	-	-	-	-	-	-	-	-	56	0.9
Chenier Plain Coastal Barrier	-	-	-	-	-	-	21	0.2	32	0.4
Grand Isle/Grand Terre Coastal Barrier	-	-	-	-	-	-	1	*	14	0.1
Dauphin Island Coastal Barrier	-	-	-	-	-	-	4	*	6	0.1
Gulf Shores Coastal Barrier	-	-	-	-	-	-	1	*	1	*
Mobile Bay/Perdido Bay Seagrass Beds	-	-	-	-	1	*	5	*	7	0.1
Vermilion/Atchafalaya Bays	-	-	-	-	-	-	-	-	21	0.2
Mobile Bay	-	-	-	-	1	*	5	*	7	0.1
Chenier Plain Marshes	-	-	-	-	-	-	21	0.2	32	0.4
West Deltaic Plain Marshes	-	-	-	-	-	-	-	-	91	2.4
Cameron Parish Rec. Beaches	-	-	-	-	-	-	21	0.2	27	0.3
Fourchon Rec. Beaches	-	-	-	-	-	-	2	*	16	0.2
Grand Isle Rec. Beaches	-	-	-	-	-	-	1	*	14	0.1
Louisiana Rec. Beaches	-	-	-	-	-	-	-	-	47	0.6
Mississippi Mainland Rec. Beaches	-	-	-	-	-	-	13	0.1	16	0.2
Mississippi Rec. Beaches	-	-	-	-	-	-	-	-	34	0.4
Dauphin Island Rec. Beaches	-	-	-	-	-	-	4	*	6	0.1
Gulf Shores Rec. Beaches	-	-	-	-	-	-	1	*	1	*
Alabama Rec. Beaches	-	-	-	-	-	-	-	-	7	0.1
Emerald Coast Coastal Barrier	-	-	-	-	1	*	-	-	1	*
Emerald Coast Rec. Beaches	-	-	-	-	-	-	-	-	1	*
Florida Rec. Beaches	-	-	-	-	-	-	-	-	1	*
Keys Brown Pelican Nest/Forage	-	-	-	-	-	-	-	-	20	0.2
Everglades Manatee	-	-	-	-	-	-	19	0.2	19	0.2
Everglades Mangroves	-	-	-	-	-	-	19	0.2	19	0.2

Note: - = less than 0.5%; * = 0.0%. Segments with less than 0.5% probability of one or more contacts within 10 days are not shown.

Source: Hannon and Lear, 1989.

Louisiana Rec. Beaches	Cameron Parish Rec. Beaches Fourchon Rec. Beaches Grand Isle Rec. Beaches
Mississippi Rec. Beaches	Gulf Is. National Seashore Rec. Beaches Mississippi Mainland Rec. Beaches
Alabama Rec. Beaches	Dauphin Is. Rec. Beaches Gulf Shores Rec. Beaches
Florida Rec. Beaches	Emerald Coast Rec. Beaches Panama City Beach Rec. Beaches St. Joseph Spit Rec. Beaches Franklin County Rec. Beaches Central Florida Rec. Beaches

For each planning area, the appropriate table shows the risks from several sources of oil, both from within and from outside the planning area. These include the proposed volume expected to be discovered and produced as a result of this sale, the Base Case, and a High Case for the proposal. Estimates for volumes of oil expected to be produced as a result of prior sales in this planning area, as well as for future sales, are added to the Base Case volume to indicate the risk presented by all OCS activities within the planning area. This Total Planning Area (TPA) volume is combined with other TPA's and imports of foreign crude into the Gulf to indicate the risk of oil spills from all activities--the Aggregate--on the Federal OCS.

The 3-, 10-, and 30-day increments were selected to represent three critical phases of a spill--greatest toxicity, maximum slick size, and tarball formation, respectively. Because of the characteristics of the crude oil expected to be produced in the Gulf and because the values for "within 10 days" necessarily include the values for the "within 3 days" category, most analyses in this EIS focus on the 10-day values, considering this a conservative approach. In the OSRA run for the Base Case, only one land segment shows a detectable chance of a spill occurring and contacting it within 3 days. This is Plaquemines Parish in the Central Gulf. No spills were estimated to occur and contact any of the land segments in the Eastern or Western Gulf as a result of the Base Case. In all cases, the probabilities (expressed as a percentage) and mean values are lower than those for 10 days. For the 30-day increment, one land segment in the Western Gulf and two land segments in the Central Gulf have detectable values; there are none in the Eastern Gulf. These land segments are shown below.

Western Gulf			Central Gulf		
Land Segment	Prob.	Mean	Land Segment	Prob.	Mean
10-Galveston, Tex. et al.	1	0.0	16-Terrebonne, La.	3	0.0
			19-Plaquemines, La.	4	0.0

Large Oil Spill Assumptions of Contact and Occurrence

Large oil spill occurrences do not follow a deterministic law; they occur at random as stated earlier. In such cases, any attempt at spill prediction must use the methods of probability and statistics. Application of these methods results in a measure of the likelihood of spill occurrence. The analyst, using his/her insight, must interpret the meaning of the likelihood in applying the spill statistics to the analysis of spill impact on resources. This section presents assumptions to be used for analytical purposes regarding the occurrences of large (1,000 bbl or greater) oil spills over the 39-year life of the proposed action. These assumptions are as follows:

(1) Base Case
  - Central Gulf of Mexico - one large crude oil spill occurrence
  - Western Gulf of Mexico - one large crude oil spill occurrence
  - Eastern Gulf of Mexico - one large crude oil spill occurrence

(2) High Case
  - Central Gulf of Mexico - one large crude oil spill occurrence
  - Western Gulf of Mexico - one large crude oil spill occurrence
  - Eastern Gulf of Mexico - one large crude oil spill occurrence

Sources: Tables IV-15 and IV-16.

4. Major Sources of Oil Contamination in the Gulf of Mexico

Petroleum hydrocarbon contamination of the Gulf of Mexico is occurring from a number of offshore, coastal, and land-based sources. Major sources of petroleum hydrocarbons in Gulf waters include natural seeps; offshore oil production; atmospheric inputs; marine transportation (especially tanker operations); coastal, municipal, and industrial wastes; and urban and river runoff. The presence of petroleum hydrocarbons in the marine environment is, to some extent, unavoidable. The petroleum hydrocarbons found in the Gulf are generated by both natural, geochemical processes and by anthropogenic inputs. Although the Gulf comprises one of the world's most prolific offshore oil-producing provinces, onshore sources of petroleum far outweigh the contributions from the domestic production of oil.

The MMS database on oil spills (Krahl, written comm., 1989) shows that 67,461 bbl of oil and condensation were spilled from OCS oil exploration, development, and production operations during the years 1971-1987. This is an average of 3968 bbl per year, or 0.000541 million metric tons annually (mta). Besides oil spills, oil may enter Gulf waters from operational discharges of produced waters. Produced water discharged (after treatment that removes the majority of the entrained oil content) contains, on an average, 25 ppm (USEPA, 1976). This average oil content was multiplied by an average 25 ppm amount of OCS produced water discharged (Section IV.A.4.k.(1)) of 1.18 billion bbl per day to determine the contribution to the petroleum loading of Gulf waters from OCS discharged produced waters. This calculation results in an estimate of 0.002 mta of petroleum hydrocarbons entering Gulf waters from operational discharges associated with OCS production. Adding this amount to the contribution from OCS-related spills of 0.0005 mta results in an estimate of the total contribution from OCS operations of 0.003 mta.

The following assessment was undertaken to put into perspective the relationship between petroleum loadings to Gulf waters from federally supervised oil-production activities and from other anthropogenic sources and compares the relative contribution of OCS operations to other sources of petroleum in Gulf waters. It is important to understand that this exercise provides only order of magnitude rough estimates. There are major problems associated with any attempt to establish values for the inputs and flux of petroleum into the Gulf. The approach taken here is to utilize the concepts, assumptions, and estimates developed by the National Academy of Sciences (NRC, 1985) and to apply them to Gulf of Mexico values. Furthermore, the contribution from petroleum sources in Mexico and Cuba was not calculated.

a. Assumptions and Probabilities of Oil Spill Occurrence and Contact for the OCS Leasing Program-related Spills

The assumptions regarding the occurrence of large oil spills for the Base and High Case scenarios were presented and discussed in Section IV.C.3.b. The occurrence of large oil spills due to total OCS production activities (past, present, and future oil production) are presented and discussed below. The potential mean number of spills that may occur in the Gulf of Mexico due to total OCS activities are 11 large spills during the 39-year life of the proposed action. These spills are distributed in the following way:

Western Planning Area - About two large spills with an 80 percent probability of occurrence over the 39-year life of the proposed action.

Central Planning Area - About eight large spills with over a 99 percent probability of occurrence over the 39-year life of the proposed action.

Eastern Planning Area - About one large spill with a 42 percent probability of occurrence over the 39-year life of the proposed action.

b. Assumptions and Probabilities of Oil Spill Occurrence and Contact for Import Tanker Spills

The potential mean number of spills predicted from the import tankering of crude-oil activities is about 47 large spills over the Gulf of Mexico region, with a 99 percent probability of occurrence. The potential number of large spills from the "in port" activities is 21 large spills distributed among the largest ports in the Gulf of Mexico. The probabilities of occurrence range from about 19 percent to over 99 percent. Most ports have a probability of over 87 percent, and only two ports have probabilities below 87 percent (Table IV-16).

The aggregate number of spills from OCS activities during the 39-year life of the proposed action, including import and OCS shuttle tankering and OCS activities, is 79 large spills.

c. Chronic and Low-level Inputs

While large spills capture the public attention and can cause serious detrimental effects, chronic, low-level inputs of petroleum hydrocarbons represent the greatest source of petroleum contamination to the Gulf of Mexico. Major sources of such discharges include operational discharges from tankers while at sea and coastal, municipal, and industrial discharges and runoff. Marine transportation is discussed in Section IV.C.4.f.

The Mississippi River is a major source of petroleum contamination, carrying large quantities of petroleum hydrocarbons into Gulf waters. Gulf of Mexico sediment samples collected within a broad crescent around the River reflect petroleum contamination from the river's discharge (Southwest Research Institute, 1981; Brooks and Giammona, 1988). The NAS (NRC, 1985) states that 0.13 mta of hydrocarbons enter the world ocean from river runoff that drains the interior of the United States Accounting for the fact that the Mississippi River drains two-thirds of the U.S. petroleum hydrocarbons in the River's discharge due to upriver drainage alone could be assumed to be approximately two-thirds of 0.13 mta; i.e., it could be estimated to be approximately 0.009 mta. However, much of the hydrocarbon burden measured at the mouth of the Mississippi River as it empties into the Gulf is due to coastal inputs. Urban runoff and routine, low-level effluents from industry wastewaters and municipalities located along the river in the area near the Gulf of Mexico contribute large quantities of petroleum hydrocarbons. These sources are accounted for in the following estimates of inputs from other chronic, low-level sources.

Man's extensive use of fossil fuels, as well as lack of recycling of discarded oils, is reflected in the large contributions of petroleum hydrocarbons found in municipal wastewaters and urban runoff. Significant amounts of petroleum hydrocarbons are deposited in urban areas from a variety of sources--asphaltic roads; the protective asphaltic coatings used for roofs, pipes, etc.; oil used in two-cycle engines, especially outboard boat motors; gas station runoff; and unburned hydrocarbons in car exhaust. These sources are either directly flushed by rainfall and runoff into storm drains and into coastal waters or rivers or are weathered, broken down, and then dispersed. The Automotive Information Council recently estimated that 8.3 million bbl (approximately 1.2 mta) of used motor oil is generated annually in the U.S. by do-it-yourselfers. They estimated that 60 percent of this is poured on the ground, thereby adding 5.7 million bbl of oil to the urban environment annually (0.814 mta). Much of this discarded oil contributes to the petroleum loading found in municipal wastewaters and urban runoff. The NRC (1985) determined that municipal wastewaters and urban runoff contributes almost 26 percent of petroleum contamination to the world ocean. To determine an estimate of the amount of petroleum entering the Gulf from urban runoff and municipal wastewaters the NRC methodology was applied to Gulf of Mexico statistics. Using a Gulf of Mexico U.S. coastal population of 14.7 million people (USDC, NOAA, 1990), calculations result in a rough estimate of 0.024 mta and 0.005 mta from U.S. municipal wastewaters and urban runoff, respectively.

Other major land-based sources of petroleum hydrocarbons in Gulf waters include refineries and other industry effluents. Coastal refineries in the Gulf area have an total design capacity of 3.4×10^8 mta. Using a discharge rate for U.S. refineries of 0.005 kg/mta capacity (NRC, 1985), the contribution of petroleum hydrocarbons from Gulf coastal refineries is 0.002 mta. These discharges enter coastal rivers (particularly the Mississippi River) that drain into the Gulf or directly drain into coastal waters. The NRC did not provide a methodology for estimating the contribution of nonrefinery industrial wastes. The number they generated was based on an average from several data sources. If one assumes that such industries are evenly distributed in the U.S. coastal zone, and if the NRC's estimate of nonrefinery industrial waste input (0.2 mta) is multiplied by one-third (the NRC's estimate of U.S. waters compared to world waters) than multiplied by the ratio of the U.S. coastal population to the Gulf of Mexico's population, a estimate of 0.009 mta of industrial effluent petroleum hydrocarbon contribution can be made.

Adding together these estimates for low-level, petroleum hydrocarbon contamination from river runoff, municipal wastewaters, urban runoff, refinery effluents, and other industry wastewaters, an overall estimate of 0.049 mta annually is given. This estimate is approximately 16 times greater than the estimate of 0.003 mta given for the contribution from OCS oil exploration and production spills and operational discharges.

Sections IV.A.4.k.(2), IV.B.4.d., IV.D.1.a.(3)(a), IV.D.2.a.(3)(a), and IV.D.3.a.(3)(a) provide further information on the contributions of routine point and nonpoint source discharges to environmental damage.

d. Projected Median Spill Size

Examination of historical spill events shows that the amount of oil spilled during any one incident can vary greatly. While 781 spills of less than 50 bbl and greater than 1 bbl have occurred since 1971, only one spill greater than 100,000 bbl, a 160,638-bbl spill, has occurred in the Gulf of Mexico from OCS operations. Section IV.C.1.c. provides more detail on historical oil-spill occurrence.

Despite inherent variability, an expected "typical" size spill is useful in order to project the fate and effects of spills occurring in association with the OCS oil and gas industry operations. The following table provides a median spill size for spills greater than or equal to 1,000 bbl occurring from pipelines, platforms, and tankers. The size tankers projected to be used to transport the oil produced from the three sales are 20,000 dwt (about 133,000 bbl) in the CPA and WPA and 50,000 dwt (about 333,000 bbl) in the EPA. The "median" of a set of measurements is defined as the middle value when the measurements are arranged in order of magnitude. The median size is used because it is considered a better indicator of a "likely" spill size since the average size is skewed by a few very large oil spill events.

Source	Median Size (bbl)
Pipelines	6,000
Platforms	7,000
Import Tankers	
at sea and near port	15,000
at sea only	21,000
near port	6,000
Shuttle Tankers	
CPA and WPA	21,000*
EPA only	21,000*

*Because no median size spill for shuttle tankers in the two size classes expected to be used is known, a conservative approach has been taken, and the median size spills for all tankers is used here.

Source: Anderson, personal comm., 1989.

Because the combined OSRA model probabilities used by the analysts can represent a spill from any source or can be a combination of all three sources, depicting the spills by location (planning areas) rather than source is useful for analytical purposes. It is important to understand that the following spill sizes represent weighted medians for occurrence (Table IV-15), not contact to environmental resources Because no median spill size is known for spills from shuttle tankers, the median spill size for import tankers was used as a conservative approach. The High Case is sometimes less than the Base Case because the source of the spill changes, for example, from tankering to pipelining. The "aggregate" spill size represents spills from all OCS Gulfwide development during the 39-year life of the proposed action and is 18,500 bbl.

	Base Case	High Case
CPA	6,500	6,500
WPA	8,600	8,500
EPA	15,400	14,500

Source: USDI, MMS, Gulf of Mexico OCS Region estimates, 1989.

e. Natural Oil and Gas Seepage

Natural sources are estimated to compose approximately 8 percent of the hydrocarbons in the marine environment. Natural seeps account for 80 percent of the total and contribute 0.02 to 2.0 mta with erosional processes contributing merely 0.005 to 0.5 mta, or 20 percent, to the marine environment (NRC, 1985).

The erosional input of petroleum to the marine environment can only be approximated because the amount has never been assessed previously. To complicate the problem, assuming organic carbon is derived from petroleum, estimations reveal no distinctions between (1) carbon from biological sources, (2) carbon from pollution, and (3) carbon indigenous to eroded sediment. The organic carbon, indigenous to eroded sediment, originates from clastic and carbonate rock particles that are eroded from sedimentary rock formations (Ronov, 1976). Furthermore, sedimentation in estuaries leading to the marine environment presents a major problem in evaluating the erosional input of petroleum.

The occurrence of marine seeps is enhanced by a large number of geologic conditions that may apply. Seeps may commence from truncations of an oil reservoir; leakage along faults; fractures associated with diapirs or intrusions of shale, salt, or igneous rocks; or seepage that directly flows from source rocks (Wilson et al., 1973).

Degree and timing of geologic basins are criteria for a higher potential of oil seepage. During later stages of the evolution of a basin, structural activity is high. Strike/slip faulting associated with numerous earthquakes contributes to the high potential for hydrocarbon seepage (Koons and Monaghan, 1976). Furthermore, thick and geochemically mature Tertiary sediments, generating hydrocarbons from source rocks, are essential for a higher capability of oil seepage. Hydrocarbon generation is primarily dependent upon the geothermal gradient and the geologic age of the sediments.

Deep-water research in the Gulf of Mexico in recent years has focused on several areas where natural seeps occur on the continental slope. As part of an MMS study entitled *Northern Gulf of Mexico Continental Slope Program*, seeps of both oil and gas have been observed and photographed from deep submersibles and remote vehicles and have been found to support chemosynthetic communities of large tube worms, mussels, and clams. These organisms derive their nutrition from dissolved gases, such as methane and hydrogen sulfide, and do not require the usual organic food sources from photosynthesis. Research funded by the Offshore Operations Committee (Brooks et al., 1986b) has demonstrated that these communities occur widely on the northern Gulf continental slope at sites of oil and gas seeps.

Historically, seepage on land was used as an early exploration tool with accounts of submarine seep occurrences rather scarce. This is due to the difficulty in observing submarine seeps. Better technology in the future will undoubtedly reveal submarine seeps not previously identified.

f. Other

Besides the sources of petroleum inputs described above, maritime transportation, atmospheric inputs (removal of particulate materials by rain), and other crude-oil and petroleum-product spills from State oil and gas operations contribute petroleum to the Gulf. Spills can occur at onshore oil-development and -production platforms, pipelines, service bases, and terminals and also at refineries, storage tanks, railroad cargo trains, and trucks hauling oil products.

Marine-transportation activities are a major source of petroleum to Gulf of Mexico waters although no estimates of their contribution are made. The NRC (1985) estimated that maritime activities contributed about 46 percent of the petroleum inputs to the world ocean. This contribution is concentrated along the principal transportation routes and in harbors and ports where oil tankers or other vessels are loaded and unloaded. Marine transportation can contribute oil to the sea through operational discharges, drydocking and marine terminal activities, bunker operations, bilge and fuel oil loading and unloading, deck washings, and accidental spills (NRC, 1985). The majority of this contamination comes from operational discharges of tankers rather than the often dramatic oil-spill incidents. Operational discharges from tankers are discussed in some detail in Sections IV.A.3.d.(3) and IV.B.3.h. Most spills are small and can occur from tank ships, tank barges, and dry-cargo barges and ships.

5. Oil Spill Prevention

Oil and gas operations conducted on the Gulf of Mexico OCS are subject to many requirements with regard to providing safety for personnel and the prevention of pollution. The basic government document that addresses these requirements are those regulations contained under 30 CFR 250. Within 30 CFR 250 there are many Subparts addressing specific aspects of these operations, such as Subparts D, E, F, H, and J, which address drilling, completion, workover, production, and pipelines, respectively. Subpart C outlines various procedures and equipment for containment and control of oil spills on drilling and production facilities. In addition, the American Petroleum Institute (API) has published numerous technical specifications and Recommended Practices (RP), which have been incorporated by reference into the aforementioned regulations. The most prominent of these specifications and practices is API RP 14C, which provides design and installation criteria for surface safety systems on offshore platforms.

Production Operations

The purpose of a platform surface safety system is to protect personnel, the environment, and the facility from threats to safety caused by the production process. The major objective of the safety system is to prevent the release of hydrocarbons from the process and to minimize the adverse effects of such releases if they occur. The overall objectives may be enumerated as follows

a. prevent undesirable events that could lead to a release of hydrocarbons;

b. shut in the process or affected part of the process to stop the flow of hydrocarbons to a leak or overflow if it occurs;

c. accumulate and recover hydrocarbon liquids and disperse gases that escape from the process; and

d. shut in the process in the event of a fire.

The platform safety system provides two levels of protection to prevent or minimize the effects of an equipment failure within the process. The two levels of protection are independent of and in addition to the control devices used in the normal process operation. In general, these two levels are provided by functionally different types of safety devices for a wider spectrum of coverage. These protective measures have been common industry practices and proven through many years of experience.

The majority of threats to safety on a production platform are caused by the release of hydrocarbons. Thus, the analysis and design of a production platform safety system must focus on preventing such releases by stopping the flow of hydrocarbons to a leak and by minimizing the effects of hydrocarbons that are released. To accomplish this, safety systems utilize protection concepts to prevent the occurrence of undesirable events. An undesirable event is an adverse occurrence in a process component which poses a threat to safety and may result in the accidental release of hydrocarbons.

In a production safety system these undesirable events are detected by various types of sensors that initiate shutdown action to prevent or limit the release of hydrocarbons from a well or process vessel. These sensors can be installed on the specific well or process vessel or as part of the Emergency Support System (ESS). The ESS includes

a. the combustible gas detection system to sense the presence of escaped hydrocarbons and to initiate alarms and platform shutdown before gas concentrations reach the lower explosive limit;

b. the containment system to collect escaped liquid hydrocarbons and initiate platform shutdown;

c. the fire loop system to sense the heat of a fire and to initiate platform shutdown;

d. the Emergency Shutdown System (ESD) to provide a method to manually initiate platform shut down by personnel observing abnormal conditions or undesirable events; and

e. the subsurface safety valves (SSSV), which may be self-actuated or actuated by an ESD system and/or a fire loop system, located within the wellbore of every well.

The undesirable events that are addressed in the design of a production platform safety system with regard to pollution prevention are overpressure, leak, liquid overflow, gas blowby, and underpressure.

Overpressure

Overpressure is pressure in a process component in excess of the normal operating pressure range. The primary protection utilized to detect an overpressure condition is a high-pressure sensor (PSH). The PSH is set at a pressure no higher than 15 percent above the highest operating pressure of the pressure component. If an abnormal condition occurs and pressure within this component reaches the PSH set pressure, it invokes shut down of the incoming valve. In cases of primary failure, secondary protection is provided by a pressure relief valve (PSV). If the primary protection (PSH) was unable to detect or initiate shut down, then the excessive pressure would be relieved through the PSV to a relief containment system.

Leak

A leak is the accidental escape of fluids from a process component to the atmosphere. The primary protection from leaks of a significant rate creating an abnormal operating condition within a pressure component is provided by a low-pressure sensor (PSL) and a flow safety valve (FSV). The PSL is set at a pressure no lower than 15 percent below the lowest operating pressure of the pressure component. If a significant leak were to incur and the pressure within this component dropped to the PSL set pressure, it would invoke shut down of the incoming valve. An FSV is basically a valve fitted with a flapper gate, allowing production flow in only one direction thereby minimizing backflow of downstream production to flow to the leak. Secondary protection is provided by the ESS. The gas detection system on a production platform would sense and initiate shut in before a leak became significant.

Liquid Overflow

Liquid overflow is the discharge of liquids from a process component through a gas or vapor outlet. The primary protection for liquid overflow is provided by a level sensor high (LSH). If an abnormal high liquid level occurred within a process vessel, then activation of this sensor would shut off production to the process component.

Secondary protection from liquid overflow to the atmosphere is provided by the ESS, as in the case of a leak occurrence discussed previously. Additionally, secondary protection from liquid overflow to downstream components would be provided by downstream safety devices on those components.

Gas Blowby

Gas blowby is the discharge of gas from a process component through a liquid outlet. The primary protection from gas blowby is provided by a level sensor low (LSL). If an abnormally low liquid level occurred within a process component, then this sensor would effect shut in of incoming production to the vessel. Secondary protection is provided by safety devices on the downstream process component.

Underpressure

Underpressure is pressure in a process component that is less than the design collapse pressure. This undesirable event is generally experienced within stock tanks where production is transferred by pumps to departing pipelines. The pumps, in transferring production, impose a vacuum on the tank. The primary protection for underpressure is the installation of an adequate vent system. Secondary protection is provided by an additional vent or a pressure-vacuum safety device. This device serves to protect the component from excessive pressures or a vacuum.

Drilling and Workover Operations

With respect to drilling operations, control of well formation fluids (oil, gas, and water) is of main concern. Primary and secondary levels of protection are implemented to maintain control of the well while drilling. The primary level of control is provided by the hydrostatic pressure of the drilling mud. Control is maintained by the circulation of properly weighted mud. The weight of the mud is adjusted to provide a sufficient hydrostatic margin over the estimated formation pressure. This hydrostatic margin allows for safe drilling without taking a "kick" from drilled formations. Various rig equipment monitors the mud system to ensure that this margin is maintained and that the system is working as designed. Monitoring of the mud system is accomplished through the use of mud pit indicators (gain or loss), flow indicators, and gas detection. When this equipment detects pit gain, flow, or the presence of gas, the secondary level of control can be initiated. This second level of control is comprised of the blowout preventer (BOP), rig mud pumps, and the choke manifold. This equipment allows for control of the well when formation pressure exceeds the hydrostatic pressure of the mud. The BOP is composed of a series or a stack of rams, which are designed to seal the wellbore at the surface to prevent flow. The stack includes at least two rams equipped to close on drill pipe, one blind ram, and one annular type--all of which can be hydraulically operated from remote stations on the rig. Once the well is shut in, the mud can be weighted up and pumped downhole with the rig pumps. While the mud is pumped, the hydrostatic pressure on the formation is maintained utilizing the choke system. Control of the well is reestablished once the weighted mud is circulated throughout the well.

This two-tiered level of control has been well proven through many years of drilling. This is illustrated by the extremely low blowout occurrence record.

Developing Technologies

In the interest of improving safety and oil-spill prevention, several new approaches are being developed to improve current technology. Much of the new technology is in the area of Systems Control and Data Acquisition. These systems are capable of computer monitoring numerous points for abnormal pressure,

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temperature, or volume conditions. Additionally, these systems can provide offshore operators a means of remote monitoring and shut in of unmanned facilities. Another technology being developed is the remote video monitoring of a facility utilizing remote-control video cameras. This technology could provide an operator with a means of remote-control visual inspection of an unmanned facility. In regard to drilling technology, the measurement while drilling (MWD) systems currently being implemented provide the driller with a nearly instantaneous reading of wellbore pressure and an indication of potential kicks. Systems such as these allow the driller to react quicker to blowout possibilities. New approaches are constantly being analyzed for improving the prevention of accidental hydrocarbon releases.

6. Oil Spill Contingency Planning and Response

The ability to prevent, contain, and clean up oil spills has become an even greater area of concern and focus for MMS, the oil industry, and the general public after the March 24, 1989, *Exxon Valdez* grounding on Bligh Reef in Prince William Sound, Alaska, where over 260,000 bbl of oil were spilled. Although the spill was not a result of activities conducted in association with OCS oil and gas development, it showed that existing government and industry cleanup operations were ineffective in containing such a large oil spill. A report to the President on the Alaskan spill that was prepared by the National Response Team (NRT) stated, "The lack of necessary preparedness for oil spills in Prince William Sound (Alaska) and the inadequate response actions that resulted mandate improvements in the way the nation plans for and reacts to oil spills..." (Skinner and Reilly, 1989). As a result of the Alaskan *Exxon Valdez* incident, industry, MMS, and the NRT initiated reviews of their spill-response capabilities and are currently in the process of upgrading their response readiness accordingly. Consequently, the MMS spill-response program as described in this section is still in the process of ongoing assessment and change. Section IV.C.6.f. includes a discussion of considered changes in present spill-response procedures.

a. Responsibility and Authority

Spill response to an OCS-related operation requires coordination among the USCG, MMS, and industry in order for an effective response to take place. A Memorandum of Understanding dated August 29, 1989, outlines the responsibilities between USCG and MMS. The Minerals Management Service is responsible for spill abatement and mitigation measures on or within 500 m of a platform, drilling rig, or other OCS facility. The USCG has the ultimate responsibility for ensuring that the oil spill incident is effectively cleaned up. The USCG can oversee any spill response activity undertaken by the OCS oil industry, but usually acts only if the spill is major. The OCS operators are required to prevent pollution, inspect and maintain oil spill response equipment, develop oil spill contingency plans, and conduct drills and training for oil spill response personnel. Section I.B.3.b.(3) further outlines industry requirements for environmental safeguards.

b. Oil Spill Contingency Planning

Oil spill contingency plans (OSCP's) provide spill response guidelines to responsible parties when a spill occurs. These plans provide for the preplanning, management, and coordination of all of the operations at the scene of a spill, as well as of the communications between involved parties at the time of a spill. The goal of the development of such plans is having the ability to provide an efficient, coordinated, and effective response to oil spills. Generally, these OSCP's should contain information on (1) who is notified when a spill occurs and the conditions under which notification takes place; (2) divisions and specifications of responsibilities and roles for involved parties; (3) logistics that need to be carried out in order to initiate a spill response; (4) methodologies to be used in determining the trajectory of a spill and its chemical characteristics; (5) procedures for undertaking cleanup and disposal; (6) identification, procurement, maintenance, and storage of equipment and supplies to be used; and (7) data on the location and sensitivity of potentially affected resources.

The Federal Government's statutory requirements for contingency planning are outlined in the Federal Water Pollution Control Act (commonly called the Clean Water Act) and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). Section I.B.4.i. describes information found in the National Oil and Hazardous Substance Pollution Contingency Plan (commonly called the National Contingency Plan). This Plan calls for the establishment of a system of Federal regional plans (Regional Contingency Plans, or RCP's) that fulfill the same requirements on a regional level as the National Contingency Plan. Two Regional Contingency Plans operate in the Gulf and are maintained by USCG Regions IV and VI. When the spill occurs in coastal and offshore navigable waters of the United States, the USCG Captains-of-the-Port are designated as the On-Scene Coordinators (OSC's). Duties of the OSC include notifying the responsible party of the spill, encouraging the party to undertake proper countermeasures to mitigate the effect, directing and monitoring cleanup progress, and providing advice and counsel to the spiller as necessary. To provide support to the OSC, a Regional Response Team, which consists of 12 representatives from Federal agencies as well as representatives from State and local agencies, has been established. The Regional Response Team serves as a regional body for oil spill preparedness planning and can be convened at the request of an OSC for coordination and advice during a spill incident. The DOI is a member of the Regional Response Team. The DOI assists the OSC at the time of a spill by providing special expertise relating to land management, fish and wildlife habitat, and water resources management. A Scientific Support Coordinator is provided by NOAA to coordinate and develop scientific response information as needed. The National Contingency Plan also requires Federal local plans (Local Contingency Plans) for areas in which the Coast Guard provides the predesignated OSC's. Each level of planning is designed to contain more site-specific information to allow the USCG to quickly organize an effective response to a pollution incident, if necessary.

During an OCS operations-related spill event, the U.S. Coast Guard's OSC will make every reasonable effort to have the operator voluntarily and promptly clean up spilled oil. Per regulation requirement, it is the responsibility of all OCS oil industry operators to take immediate corrective action when an oil spill has occurred.

To effectively accomplish oil spill containment and removal actions, the MMS requires that all Exploration Plans (POE), Development and Production Plans (POD), and Development Operations Coordination Documents (DOCD) be accompanied by an OSCP. In order to facilitate this requirement in the Gulf of Mexico region in a practical manner, it is expedient for each OCS operator to submit for approval a regional OSCP that covers all of their operations in the Gulf of Mexico. The approved regional OSCP is then referenced when POE's and DOCD's are submitted. However, the operator may elect or may be required by MMS to include a site-specific OSCP in a POE or DOCD when the approved regional OSCP does not provide adequate oil spill protection or when lease stipulations for leases in the Eastern Gulf of Mexico require response capabilities beyond those described in the operator's approved regional OSCP.

The OCS operators are required to prepare OSCP's in accordance with the requirements of 30 CFR 250.42. However, since OCS operators in the Gulf of Mexico region prepare regional OSCP's, the MMS has issued a Letter to Lessees (LTL) dated February 1, 1989, which outlines the requirements for regional OSCP's. In addition, LTL's dated October 12, 1988, and September 5, 1989, were issued. These LTL's list the oil spill information that must accompany every POE or DOCD when the POE or DOCD references an approved regional OSCP. This information includes (1) an identification of the primary location of containment and removal equipment; (2) an estimation of the individual times for procurement of the equipment, the equipment transportation vessel, and the personnel to load and operate the equipment as well as equipment load-out, travel time to the deployment site, and equipment deployment; and (3) a discussion that identifies the zones that appropriate and available trajectory analysis indicate may be impacted by an oil spill, the environmentally sensitive resources and areas within the impact zones, and the strategies to be used to protect these resources from oil spills. Site-specific OSCP's are prepared in accordance with the requirements of 30 CFR 250.42 and, in addition, address those items that the MMS has identified as necessary or those that are required by lease stipulation.

Besides the Federal Government and private industry, there are contingency plans developed at the State and local authority levels. The States of Florida, Texas, Alabama, and Mississippi have oil and hazardous substances pollution contingency plans for their coastal areas. The State of Louisiana is presently developing a set of criteria that defines and establishes a process for responding in the event of a spill.

Review of Contingency Plans

The Federal Government's network of contingency plans outlined above is reviewed through two mechanisms. Draft National and Regional Contingency Plans are published in the *Federal Register* for an appropriate time period to allow review of the plans by all interested parties. All members of the Regional Response Team are given an opportunity to review the draft plans to ensure that the plans recognize and integrate their agency's responsibilities. Through the DOI's Regional Response Team member, MMS can provide comments on Regional and Local Contingency Plans to assure that the plans conform with MMS policies and procedures and that the notification process addresses MMS responsibilities regarding oil spill cleanup on the OCS.

The OCS oil industry's oil spill contingency plans, as well as the supplemental information submitted with POE's or DOCD's, are reviewed by MMS. This review attempts to ensure that an operator's identified response time is reasonable, accurate, and sufficient to protect the adjacent environmental resources. Response times are further reviewed to determine whether they include sufficient time for the procurement of a vessel, for load-up and mobilization of cleanup equipment, and for transportation and deployment of the equipment. Based on the results of this review, it is determined whether the primary oil spill response equipment location identified by the operator is appropriate for the subject plan or whether the projected response time allows sufficient containment/cleanup time prior to a spill potentially hitting the shoreline.

If the analysis indicates that a potential spill could possibly contact the shoreline in an environmentally sensitive area prior to the operator reaching the spill site and/or without allowing sufficient time for cleanup, the operator's response would be required to be reduced if possible; and/or as a condition of plan approval, the operator would be required to be capable of implementing the appropriate shoreline oil spill protection methodology identified or referenced in their POE or DOCD to protect those resources that potentially would be impacted within a timespan designated by this office.

c. Spill Response Training/Drills

Containment and cleanup operations are labor intensive due to the complexity of the environment they are conducted in and the constant monitoring/planning efforts associated with these types of operations. It is therefore essential that personnel be well trained in the use of the equipment and in the methodology of spill containment and cleanup. The MMS addresses this training by requiring through regulation (30 CFR 250.43) that the lessee ensures that the oil spill response operating team is provided with annual hands-on training classes in the deployment and operation of pollution-control equipment. Those responsible for supervising the oil spill response operations are required to be trained in directing the deployment and the use of all response equipment.

As of May 1989, MMS has conducted four unannounced drills in the Gulf of Mexico of randomly selected operators and offshore locations ranging from Florida to Louisiana. In all instances, a team of MMS officials initiated the drills and monitored the timing and actions taken by various company officials at several key locations. Although most of the drills were initiated early in the day, one drill held February 1, 1990, was conducted as a night exercise. Varying scenarios were utilized ranging from a simulated 200-bbl diesel fuel spill from a storage tank in the Destin Dome area that resulted in onsite equipment deployment to a simulated 1,000-bbl storage tank rupture combined with a 600-bbl/hr pipeline spill some 62 miles south of New Orleans that resulted in a combination of equipment mobilization and simulated table-top exercises. After each drill, recommendations for improvement were provided to the participating operator by MMS. While each exercise identified some areas that could be improved, the Gulf of Mexico Regional Director for MMS indicated that each company's response effort in each instance was timely and well executed.

Drills for familiarization with pollution-control equipment and operational procedures are required to be held when equipment is initially placed and thereafter on an annual basis by the lessee or his contractor. The personnel identified as the oil spill response operating team in the OSCP are required to participate in these drills. The drills are required to simulate conditions in the area of operations and include the deployment and operation of the equipment. Records of these drills are required to be maintained for 2 years. The MMS, Gulf of Mexico OCS Region, requires that these drills result in the deployment and operation of each piece of oil spill equipment maintained by Clean Gulf Associates (CGA) at least once every 4 years and that each oil spill response team participate in enough exercises such that they will have deployed every type of pollution-control equipment maintained by CGA at lease once every 4 years. The MMS may initiate unscheduled drills and may require an increase in the frequency or a change in the locations of the drills, equipment to be deployed, or deployment procedures and strategies. The MMS, Gulf of Mexico OCS Region, has recently implemented a program to conduct unscheduled drills of five or six randomly selected operators each year. The various drills include different stages of deployment of equipment and personnel. The four types of drills developed by the MMS for use in the Gulf of Mexico include (1) unannounced drills with equipment mobilization only, (2) unannounced drills with equipment mobilization and deployment, (3) spot "Table Top" drills, and (4) announced "Table Top" simulations of a large oil spill. A written report of each unannounced drill will be required to be submitted to MMS within 15 days of the conclusion of the unannounced drill. The MMS evaluates the results of these drills and advises the lesee of any necessary changes in response equipment, procedures, or strategies.

Oil spill responders are also required, through the National Contingency Plan (40 CFR 300) effective April 19, 1990, to adhere to the training and safety requirements outlined in the U.S. Department of Labor, Occupational Safety and Health Administration's (OSHA) Hazardous Waste Operations and Emergency Response regulations at 29 CFR 1910.120. Although OSHA has specifically decided that petroleum products and gases are covered by 29 CFR 1910.120, questions have been raised concerning the interpretation and implementation of these regulations for various oil-spill response conditions. Effective April 13, 1990, the OSHA requirements generally provide that spill responders, such as the equipment operators and general laborers, having a potential for minimal exposure to a hazardous substance are required to have 24 hours of initial oil-spill response instruction and 8 hours of actual field experience. Those spill responders having potential exposure to a hazardous substance at levels exceeding the permissible exposure limits (generally, those situations requiring the use of a respirator and protective clothing) are required to have 40 hours of initial training off site and 24 hours of actual field experience. Onsite management and supervisors are required to receive the same amount of training as the equipment operators and general laborers, with the addition of 8 hours of specialized training in hazardous waste management. Eight hours of annual refresher training is required of both general employees and managers. The OSHA regulations include provisions that would relax the training requirements in emergency response situations; however, there is some confusion over the interpretation of the distinction between an emergency response situation and a post-emergency response situation at this time.

d. Equipment Response and Capability

At the time of a spill on the OCS, a network of contingency plans is put into effect. Generally, if a spill results from an oil and gas facility, an operator would notify the National Response Center, which was established under the auspices of the National Contingency Plan; the MMS, Gulf of Mexico OCS Region; and his oil spill response coordinator, who may activate the operator's oil spill response operating team. At this time, equipment and manpower would be mobilized, if deemed necessary. The Local Contingency Plan of the closest Captain-of-the-Port (the OSC) would also be activated. At the request of the OSC, or if the spill crosses regional boundaries or poses a substantial threat to the environment, the Regional Response Team would be activated.

(1) Equipment Locations

In the Gulf of Mexico region, oil spill response equipment, identified in each operator's regional oil spill contingency plans, is generally maintained at nine strategically located onshore bases by the oil industry cooperative, CGA (Table IV-21). When there is drilling activity in the EPA, oil spill equipment may be strategically located at the rig site or at other staging leases (e.g., Panama City). See Section II.C.1.c.(4) for a description of the oil spill equipment requirements for drilling activity in some areas of the EPA.

This equipment is the primary equipment used to respond to an oil spill associated with OCS operations. Although the CGA equipment is acquired and maintained for use by member companies, it is also available to non-members for a scheduled fee. Table IV-21 also identifies the types of equipment stockpiled at the nine

Table IV-21

CGA's Oil Response Equipment[1]

	Offshore Booms	Coastal Booms	Offshore Skimmers	Inshore Skimmers	Sorbents	Surface Collecting Agents	Chemical Dispersants	Bird Care Equipment
Texas								
Galveston		x	x		x	x	x	x
Port Aransas		x	x		x	x	x	x
Louisiana								
Cameron			x					
Intracoastal City		x	x		x	x		x
Houma			x	x			x	
Grand Isle[2]	x	x	x	x	x	x	x	x
Venice		x	x	x	x	x		x
Alabama								
Theodore			x					
Florida								
Panama City[3]			x		x	x	x	x

[1] As of May 1989.

[2] Main base.

[3] When there is a drilling activity in the EPA, equipment is strategically located at nearby offshore staging bases; for example, Panama City. When there is no EPA drilling, the equipment is stored in Houma, Louisiana.

Source: CGA, 1989a.

Table IV-22

Number of Oil Spill Cleanup Contractors by State Stocking Various Cleanup Equipment

	Offshore Booms	Coastal Booms	Offshore Skimmers	Inshore Skimmers	Sorbents	Surface Collecting Agents	Chemical Dispersents	Bird Care Equipment
Texas	2	7	0	12	13	2	3	1
Louisiana	4	12	13	12	9	1	0	0
Mississippi	1	0	0	1	1	1	0	0
Alabama	3	6	1	5	2	0	0	0

Source: Marine Industry Group. 1988.

onshore bases. All CGA bases have offshore skimmer systems known as Fast Response Systems (FRS). The High-Volume Open Sea Skimmer System (HOSS) barge is maintained at the Grand Isle base in coastal Louisiana because of this base's proximity to a large number of oil-related activities. Further discussion of this spill-response equipment is provided in Section IV.C.6.d.(2). Other types of equipment strategically sited at CGA bases throughout the Gulf of Mexico include boat and helicopter spray systems, communications equipment, and 50-bbl oil storage barges.

The oil industry can also contract for cleanup with an extensive number of independent spill-cleanup contractors located throughout the Gulf Coast. The number of companies having various pieces of available equipment are listed by State in Table IV-22. Besides the equipment operated by numerous contractors, coastal booms and skimmers are housed near refineries and other oil and chemical industry operations to respond to spills that may occur from their own facilities. For example, at present there are 16 onshore oil companies maintaining coastal booms at their facilities. The largest and most extensive stockpile of equipment, particularly open-ocean cleanup equipment, is maintained by the Louisiana Offshore Oil Port (LOOP) located at Port Fourchon, Louisiana. Productive discussions are ongoing betwen CGA, through Haliburton Services, and LOOP towards an agreement to potentially share equipment in the event of a spill.

If the Coast Guard OSC determines that the OCS operator responsible for the spill is not taking appropriate response measures, the OSC may hire a cleanup contractor to conduct the spill cleanup. Under certain situations, the USCG National Strike Force may be called to provide assistance to the OSC. The Atlantic Area Strike Team located in Mobile, Alabama, is part of the National Strike Team and is equipped with specialized containment and removal equipment with rapid deployment capabilities.

(2) Equipment/Response Options and Effectiveness

(a) Mechanical Equipment

A wide variety of mechanical equipment is available to aid in the containment and cleanup of spilled oil. Some general categories of oil spill cleanup and containment devices include booms, skimmers, pumps, and sorbents.

Oil spill control booms are floating barriers designed to contain spilled oil for recovery, to divert oil to areas where recovery is easily carried out, and to act as a barrier in pathways to areas containing commercially valuable or environmentally sensitive resources. Boom designs vary considerably, but all of them usually incorporate the following features: freeboard to prevent or reduce splashover; subsurface skirt to prevent or reduce the escape of oil under the boom; flotation by air or some buoyant material; and a longitudinal tension member (chain or wire) to withstand the effects of winds, waves, and currents. The length and size of boom sections are important considerations. The optimum size of a boom is largely related to the sea state under which it is to be used. As a general rule, the minimum height of freeboard to prevent oil splashover should be selected; and the depth of the skirt should be of similar dimensions. Short section lengths of boom are easier to handle and can protect the integrity of the boom as a whole, should one section fail; however, this should be weighed against the difficulty of connecting the sections effectively. A boom is typically constructed of modern lightweight/high-impact materials (high strength-to-weight ratio) and packaged compactly to allow for ease in transportation and deployment. Booms generally cannot contain oil against water velocities much in excess of 1 knot (kn) (0.5 m/s) acting at right angles to it. The escape velocity for most booms is around 0.7 kn (0.35 m/s), irrespective of skirt depth (Oil Spill Intelligence Report, 1984a).

Skimmers are mechanical devices designed to collect spilled oil from the water surface for disposal without chemically or physically altering the oil. Skimmers are classified on the basis of their operating principles into the following major groups: weir skimmers (provide gravity drain off to oil); vacuum skimmers (similar to weir, but use a power source to actively remove the oil); centrifugal skimmers (where a power source is used to create a vortex that drains the oil for collection); submersion skimmers (force the oil below the water level and use its buoyant property in the collection process); and oleophilic skimmers (collect oil on a moving sorbent material and mechanically squeeze it into collection areas) (Oil Spill Intelligence Report, 1984b).

Each of these skimmer types has its advantages and disadvantages, although the efficiency of each model depends on several parameters, including oil thickness, oil viscosity, sea state, and storage capability. Each type of skimmer is best suited for a particular situation; no skimmer is effective in all conditions. In addition, since the skimmer is part of a system involving the containment and recovery of the spilled oil, as well as the separation of the oil/water mixture and the transportation of that mixture to receptacles, the overall efficiency of a skimmer depends on the effectiveness of the individual components of the system (Oil Spill Intelligence Report, 1984b).

Pumps are used in oil spill cleanup operations to transfer collected oil from a collecting device, such as a boom, to a vessel or facility for separation, reprocessing, storage, or transportation to other facilities. Although specifications of the various pumps available are not relevant to this discussion, it should be recognized that pumps are necessary for cleanup operations.

Sorbents are those materials that recover oil by either absorption or adsorption. In absorption, oil penetrates the solid structure of the absorbents' fibers or particles, which then swell in size to accommodate the oil. In adsorption, oil adheres to the surface of the adsorbent material but does not penetrate the fibers or particles themselves. Sorbent materials are generally classified by their composition: (1) natural organic products, such as hay, peat moss, straw, or wood pulp; (2) mineral compounds, such as ash, perlite, or vermiculite; and (3) synthetic products, such as polyethylene, polypropylene, or polystyrene. Sorbents are usually marketed in particulate form or as booms, pillows, rolls, or sheets. Synthetic products are generally preferred over natural sorbents because they are able to sorb more oil while taking on less water. For this reason, they take up less storage space and pose less of a disposal problem (Oil Spill Intelligence Report, 1984c).

As previously stated, winds and sea state have a significant effect on the performance of the aforementioned oil spill equipment. In general, 15-20 kn are the maximum wind speeds for dynamic upwind recovery, and recovery over sea states of 3-4 ft is essentially undocumented (Tennyson, personal comm., 1988). Of additional importance is the period of the waves. When an increase in winds produces short-period, localized seas, the efficiency of oil spill containment/cleanup devices decreases because the equipment tends to get swamped in the wash of these choppy waves. Large rolling waves (long period) present less problems due to the ability of the equipment to follow the waves' contours (Oil Spill Intelligence Report, 1984b).

Initial response to an oil spill occurring due to OCS oil-development activities is available through equipment owned by CGA. Open-ocean equipment available through CGA includes FRS and the HOSS barge. The FRS is essentially a vessel of opportunity skimming system (VOSS) in that it is designed to be loaded onto a single vessel supplied by the lessee. Vessel length can range from 65 to 100 ft. Fast Response Systems are staged at onshore locations throughout the Gulf as indicated by Table IV-21. Once an FRS unit is loaded onto a vessel, the vessel is generally capable of a 10- to 15-kn response dependent upon the size of the vessel utilized. Clean Gulf Associates' FRS consists of a barrier (two sections of 24-ft lengths of 48-in boom) connected to a weir skimmer and towed alongside a single vessel with an outrigger, an oil-water separator system, and recovered oil-storage capacity.

Due to the problems of equipment and manpower coordination inherent in an oil spill response, skimming systems deployed from single, independent vessels are an attractive means of recovering spilled oil offshore. Whereas a large sweep system is advantageous on large, unified slicks, a VOSS can be deployed more quickly, is more maneuverable (for skimming windrows of oil, for example), and requires only one vessel (Crocker, 1985). Operations of single-vessel systems are presently limited by the deployment and retrieval of the skimming system in rough conditions rather than by barrier performance in waves (Crocker, 1985). The CGA reports that the FRS weir skimmer will pick up essentially all the slick presented to it at boat speeds of 3/4 to 1 1/4 kn in seas up to 2 ft. As seas pick up and/or boat speed increases, however, effectiveness of the system decreases. This system has been tested at the USEPA Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) under varying conditions with both heavy and medium oils. The tests showed that throughput efficiencies ran as high as 100 percent for speeds of 1.25 kn, with an oil recovery rate of 293 bbl of oil per hour in a slick that was 2 mm (0.08 in) thick. The skimmer was tested under severe harbor-chop conditions of 2 ft, resulting in throughput efficiencies of 70 percent (USDI, MMS, 1987d).

The HOSS barge located in Grand Isle, Louisiana, consists of a skimming system built into a specially designed 174-ft barge. Boom (1,000 ft total) is stored on two sides of the barge and is launched off the stern by means of a trolley running down ramps cut into the hull. Mounted in slots in the barge's stern are four oleophilic belt skimmers, each followed by a weir skimmer. The HOSS barge is designed to be utilized to skim extensive long-duration spills where chasing after slicks is not required and to provide offshore operational support for spill recovery. This system must be towed by barge to an oil spill site. Tow speed is typically 4-7 kn. The HOSS barge is capable of working in up to 6-ft waves with boom and 7-ft waves without boom.

The main objective in any offshore spill response effort is to prevent the oil from damaging resources by containment and recovery of the spill. The CGA currently has 500 ft of 72-inch offshore boom stockpiled at Grand Isle, Louisiana, primarily as a replacement boom to the HOSS Barge. Other offshore boom, which may currently be available through Gulf of Mexico oil and gas operators, would include the 750 ft of boom that is required to be located at each rig site or staging area in the Florida panhandle during drilling activity in those areas located in the EPA as subject to the oil spill stipulations discussed in Section II.C.1.c.(4). Booms typically utilized to fulfill the requirements of these oil spill stipulations are capable of being deployed in less than 1 hour and can generally operate effectively in 6-ft waves.

Lengths of 36-in nearshore containment booms, self-propelled skimming vessels, hand skimming systems, floating suction oil skimmers for use in shallow water, and sorbents make up a portion of the remaining inventory available through CGA. By the end of 1990, CGA should have finalized the $2 million procurement of 18,000 ft of open-ocean boom and 9,000 ft of tricompartment shoreline boom that would be strategically sited along the Gulf Coast at existing CGA bases. Clean Gulf Associates has also recently approved the initial concept of establishing four identified vessels to be strategically sited at various locations offshore and equipped to provide an initial response effort in the event of an oil spill. The first such identified vessel is targeted to be ready by August 1990; however, there are still several pending issues that need to be resolved prior to final implementation of the identified vessel concept. Establishing the identified vessel will require the procurement of additional equipment, such as skimmers, to outfit the vessels. Approximately $400,000 has been approved by CGA to outfit the first identified vessel, which is proposed to be located offshore at South Timbalier Area Block 26.

(b) Chemicals/Dispersants Usage

Chemical dispersants may potentially be used as an oil-spill mitigation tool. Tables IV-21 and IV-22 delineate locations presently stockpiling dispersants in the Gulf of Mexico. Dispersant formulations have changed since the Torrey Canyon spill in attempts to develop more effective and less toxic products. These so-called second-generation dispersants, introduced in the late 1970's, are being manufactured today. Therefore, only the current (late 1970's to the present) literature on effects of dispersed oil is relevant. Some studies have investigated the toxicity of dispersants alone (Wells, 1984). Studies that have considered species indigenous to the Gulf of Mexico, such as mangroves, seagrasses, and corals, include those by Baca and Getter (1984), Getter and Baca (1984), Getter and Ballou (1985), Teas et al. (1986), and Thorhaug et al. (1986).

The key components of chemical dispersants are surface-active agents (surfactants), which are molecules that have both water-soluble (hydrophilic) and oil-soluble (hydrophobic) ends. These molecules, when applied to an oil spill, orient themselves at the oil/water interface such that the hydrophilic ends of the molecules are in the water and the hydrophobic ends are in the oil. The result is a reduction of interfacial tension between the oil and water. This action reduces the cohesiveness of the oil slick and, with agitation, finely dispersed oil droplets (ranging in size, depending on the effectiveness of the surfactant formulation, from about 10 microns to 0.5 mm in diameter) are formed in the near-surface water. The hydrophilic surfactant groups prevent droplet recoalescence.

The decision to use dispersants must be made soon after the spill occurs. Weathering of oil will increase the viscosity and decrease the capability of chemically dispersing the oil. Factors to be considered in making this decision are oil type and properties, environmental conditions, the availability of dispersant and application equipment, and the probable fate of the oil without treatment. Highly viscous oils (greater than 5,000 centistokes), oils with pour points near or above ambient temperature, and oils with a high wax or asphaltene content may not be amenable to dispersant treatment (International Tanker Owners Pollution Federation, Ltd., 1982; Canevari, 1985). Dispersants are not recommended for use on spills on very calm waters. Some dispersants are formulated for use on marine (saltwater) spills only.

Dispersants may be applied by boat or aircraft. Boat application is limited to small spills or those within a few miles of shore. Aerial spraying is the preferred method because it offers rapid response, coverage of large areas per unit of time, good control of treatment rates, optimum use of dispersants, and much better evaluation of treatment results than is possible from boats. Regardless of the method used, the application system must deliver the proper dosage of dispersant in a uniform spray of droplets to the slick. Most oil slicks considered for dispersion will be 0.25 mm thick or less (a 0.25 mm thick slick contains over 4,000 bbl per square mile of oil). The dispersant must penetrate the oil to reach the oil/water interface. The proper dosage of dispersant (5 gal/acre is an average amount, depending on the dispersant and the oil types) must be used to attain the maximum reduction of interfacial tension. Finally, some form of energy (e.g., wind, wave, or mechanical) must be applied to the oil/water interface to cause the dispersion of oil into the upper part of the water column. Newer types of dispersants require very little mixing energy.

Dispersant use in the Gulf of Mexico is controversial and has not yet been fully accepted by the five Gulf States, which, along with USEPA, have approval authority regarding the use of dispersants in waters off their shores. The States, however, by their participation in the Regional Response Teams (RRT's) and the Dispersant Working Groups (DWG's), are reviewing relevant data with an eye to approving dispersant use under certain specific conditions. The MMS also participates in the DWG and is considering several studies in order to obtain more data on dispersant effectiveness under field conditions. Also, LOOP, Inc. is conducting toxicity tests on postlarvae and/or juveniles of brown and white shrimp, blue crab, oyster, and red drum (USDI, MMS, 1987d).

The National Research Council (NRC) of the National Academy of Sciences has addressed the effects of dispersants in its review, "Using Oil Dispersants on the Sea." The study addressed two questions about the use of dispersants: (1) Do they do any good? and (2) do they do any harm? (NRC, 1989).

> *Do they do any good?* This is not an easy question to answer. In a few carefully planned, monitored, and documented field tests, as well as in laboratory tests, several dispersants have been shown to be effective---that is, they have removed a major part of the oil from the water surface when properly applied to oils that were dispersible. However, at other field tests and at accidental spills, dispersants have been reported to have low effectiveness. The latter results may have been due to the use of inadequate application techniques, such as poor targeting and distribution of aerial sprays, as well as the possibilities that the oils were not dispersible, that some dispersants were poorly formulated, or that the results were inconclusive. Resolution of these ambiguities will require further studies. Much is known of how dispersants work, but one aspect inadequately understood is the interaction of various physical and chemical processes involved in oil dispersion.
>
> *Do they do any harm?* Concern that chemical dispersants could be toxic to marine life has led to considerable caution in authorizing their use at spill sites. Laboratory studies of dispersants currently in use have shown that their acute lethal toxicities are usually lower than crude oils and their refined products. A wide range of sublethal effects of dispersed oil has been observed in the laboratory. These occur in most cases at concentrations comparable to or higher than those expected in the water column during treatment (1 to 10 ppm), but seldom at concentrations less than those found several hours after treatment of a oil slick (less than 1 ppm). The times of exposure in the laboratory (24 to 96 hours) are much longer than predicted exposures during slick dispersal in the open sea (1 to 3 hours), and the effects would be expected to be correspondingly less in the field. Laboratory bioassays have shown that acute toxicity of dispersed oil generally does not reside in the dispersant, but in the more toxic fractions of the oil. Dispersed and untreated oil show the same acute toxicity. The immediate ecological impact of dispersed oil varies. In open waters, organisms on the surface will be less affected by dispersed oil than by an oil slick, but organisms in the water column, particularly in the upper layers, will experience greater exposure to oil components if the oil is dispersed. In shallow habitats with poor water circulation, benthic organisms will be more immediately affected by dispersed oil. Although some immediate biological effects of dispersed oil may be greater than for untreated oil, long-term effects on most habitats, such as mangroves, are less, and the habitat recovers faster if the oil is dispersed before it reaches that area.

The report went on to make several recommendations regarding future studies; it also recommended that dispersants be considered as a potential, first-response option to oil spills, along with other response options. A computer program to aid decisionmakers in determining whether or not to use dispersants under specific spill conditions has been developed by the industry. This program tracks oil and dispersed oil under conditions prevailing at the spill site and provides a comparison of the impacts under the two conditions on biological resources of the area. When fully accepted and implemented, it is expected that the program will provide a useful tool for on-the-scene decisionmakers from the States, industry, and Federal agencies to aid them in deciding whether or not to use dispersants under the specific prevailing conditions. Industry proposes using the model as a realtime predictive methodology as cited in their contingency plans. The MMS is planning a study to verify the assumptions and calculations used by the model in order to assure its usefulness.

As noted in Section IV.C.6.b. above, RRT's have been established in both Gulf Regions (IV and VI) to deal with hazardous-material spills both onshore and offshore. Both RRT's have established DWG's to advise the RRT on dispersant use. The Region VI DWG has developed a Dispersant Use Plan, which has been adopted by the RRT and has been incorporated into the Region VI Regional Contingency Plan. The Region IV DWG is proceeding to do the same. The use of dispersants may eventually be considered under appropriate conditions, but at the present time the individual states, which must concur in any decision to use dispersants, are very reluctant to approve such use until ambiguities regarding the toxicity of dispersants and dispersed oil are resolved.

The MMS policy regarding this agency's authority to grant approval to OCS operators to use dispersants within a 500-m radius of the source of pollution is limited to situations in which dispersants are deemed necessary as a measure for the safety of personnel and operations in attempting to abate the source of pollution. Approval for the use of dispersants as a measure to mitigate the discharge of pollutants is the responsibility of the U.S. Coast Guard On-Scene Coordinator.

An oil-treating agent called "Elastol," which is not a dispersant, aids in the containment and recovery aspects of oil-spill cleanup. Elastol is a nontoxic powder that dissolves rapidly when dispensed on hydrocarbon liquids. It modifies the oil, giving it a viscoelastic property and making recovery more efficient, and is usable on light and heavy crudes, kerosene, diesel, gasoline, bunker, and many other hydrocarbons. In recent tests, the application of Elastol on offshore oil spills in 500-900-ppm quantities increased the performance of skimming equipment 2-5 times over untreated performance recovery rates. It also minimized oil spreading, streaking, and breakup due to wind and wave conditions of up to 15 knots. When used with booms, it shows successful containment in currents over 1 knot. It should be noted, however, that the effectiveness of Elastol has not yet been proven under field conditions; and, like dispersants, its usefulness is still the subject of some controversy. Additional information on Elastol can be obtained from a technical paper entitled Laboratory and Tank Test Evaluation of Elastol, which was presented at the "Tenth Arctic and Marine Oil Spill Program Technical Seminar" (Bobra et al., 1987).

(3) Response Times

Although regional oil spill contingency plans submitted for the Gulf of Mexico do not specify response times, the supplemental oil-spill information submitted for POE's and DOCD's does provide a response time for operations on a particular lease. Review procedures for an operator's response time submitted as supplemental information to a POE or DOCD are discussed in Section IV.C.6.b.

The USCG has established guidelines for response times for OCS operations in Commandant Instruction 5740.6. The instructions request a target response time of 6-12 hours from the time of the spill, dependent on the location and general operating characteristics of the OCS operations. However, this 6- to 12-hour range for response times is not flexible enough to cover the wide variation in the distance of the leased areas in the Gulf of Mexico to the shoreline or to the nine CGA-designated spill-equipment bases.

Initial response times in the Gulf of Mexico to an oil spill would vary dependent upon the chosen spill-equipment base, the distance of the block to the chosen spill-equipment base, the travel speed of the chosen vessel, the amount of time needed to procure and deliver a vessel to the spill-equipment staging area, the time needed to transport the oil spill response crew to the spill-equipment loading base, the load-up time, and the deployment time. The utilization of some staging areas would require a longer period of inland water travel at reduced speeds, which could significantly increase a response time. Additionally, although most OCS operators are members of CGA, the few that are not may incur delays at the time of a spill while negotiating an agreement with the co-op for the use of the equipment.

First response to an oil- and gas-drilling-related spill in the Gulf of Mexico would generally be made utilizing CGA equipment. Each operator would be responsible for supplying their own vessels, cranes, and personnel when utilizing CGA equipment. The majority of the facilities located more than 97 km (60 mi) from an onshore equipment base currently have response times greater than 12 hours. These response times are based on an estimate of 4 hours for the procurement and mobilization of both personnel and a vessel to a subject base, an estimate of 2 hours to load the equipment onto the support vessel, an estimate that the procured vessel would travel at 10 mph in open water, and an estimated channel run time. A study of the projected response times submitted to date by Gulf of Mexico OCS operators was made to determine these estimates. Some variance of these estimated times can be expected depending upon the availability of a vessel and the distance of the spill response personnel headquarters from the subject CGA base location, as well as the wind and weather conditions at the time of a spill. It should be noted, however, than an oil spill at these distances from shore would not normally be an immediate threat to coastlines in the Gulf because (a) prevailing currents and winds do not tend to move spills directly toward shorelines, (b) the greater the distance from shore of a facility, the greater the time available before a coastline could be impacted, and (c) Gulf crudes are generally light and, therefore, easily and naturally dispersed.

A large number of operators in the Gulf of Mexico presently propose the use of contract personnel to load and operate the CGA equipment. These operators typically enter into a "no fee" type of contract with one or more of these companies to provide spill response on a 24-hour basis if they are available at the time of a spill. Because these companies are not located in close proximity to all of CGA's spill-equipment bases, the delivery of the contract personnel to a spill base for loadout could increase a projected response time. A 6-hour timeframe has been identified in some instances.

Vessel procurement has been identified by numerous OCS operators as one of the biggest limiting factors in attempting to reduce response times in the Gulf of Mexico. Vessel procurement times over 12 hours have been projected in some instances. Many operators request using a spill-equipment base nearer their onshore support base rather than a base closer to the subject lease to ensure that a vessel could be procured within a reasonable time. Most companies prefer to rely upon vessels they have already contracted with as opposed to attempting to contract or borrow a vessel from another company at the time of a spill. Other problems encountered regarding vessel procurement are the availability of large vessels (160-180 ft in length) that would be needed to respond to deep-water blocks and the limited number of spill-equipment base locations that could handle these large vessels. These factors could significantly increase an already lengthy response time to a deep-water area.

The MMS and CGA are currently assessing various options to reduce response times in the Gulf of Mexico. One such option under consideration is CGA's proposal to locate four identified and equipped vessels at strategic offshore sites along the Gulf of Mexico.

(4) Offshore Cleanup Capability for Handling Various Size Spills

The MMS-required OSCP's describe response actions for two types of spills--continuous spills and spills of short duration and limited maximum volume. Response to a very large spill, if the spill results from an instantaneous release, is not described. If the spill were very large, industry would attempt to access available equipment that could help in containing the spilled oil as identified in their OSCP's. Logistics for obtaining, transporting, manning, and deploying this equipment would, however, have to be worked out at the time of a spill. Table IV-21 and IV-22 provides a listing of available spill-response equipment along the Gulf Coast.

An examination of the daily cleanup capacity of CGA's major cleanup equipment described above can be used to predict the amount of oil that industry could remove from the slick daily. The FRS and the HOSS barge serve the industry in cleaning up spilled oil in open seas. The HOSS barge would only be used for spills of long duration, such as blowouts, because of the amount of time to transport the barge to the spill site. This system can recover a nominal amount of 4,300 bbl of fluid per day. The oil tanks can hold about 4,100 bbl and can be offloaded to other oil storage barges. The FRS's would be used for spills of short duration and to supplement the HOSS barge. The recovery pumping system of the FRS is conservatively estimated to handle

1,000 bbl per 12-hour day (Union Exploration Partners, Ltd., 1988). As previously stated, during OHMSETT testing under varying conditions with both heavy and medium oils, throughput efficiencies for the FRS ran as high as 100 percent for speeds of 1 1/4 kn, with an oil recovery rate of 293 bbl of oil per hour in a slick 2 mm (0.08 in) thick (USDI, MMS, 1987d). Clean Gulf Associates currently has 13 FRS units, which could be utilized during a spill staged at locations throughout the Gulf of Mexico. Obviously, the response capability in the Gulf of Mexico would vary depending upon the number of FRS units deployed to the spill site. In the event of a 10,000-bbl oil spill, one medium-size skimmer capable of picking up 600 bbl of fluid/hr, which would have similar capacity to one FRS, would be required for a maximum of 7 days working 12 hours/day to recover the total fluid to be recovered (50,000 bbl--20% oil/80% water). A 63,000-bbl oil spill would require six medium-size skimmers to recover the total fluid necessary (315,000 bbl of fluid) over the same timeframe (Exxon, 1979). The recovered oil-storage capacity of an FRS is 100-180 bbl. Recovered oil in excess of the 100- to 180-bbl FRS storage capacity could be temporarily offloaded to the supply-vessel tanks. However, a waiver from the USCG would have to be obtained to utilize the mud tanks in the supply vessel for auxiliary recovered oil storage. Other options for additional recovered oil storage would include the 50-bbl oil storage barges available through CGA or oil barges located throughout the Gulf of Mexico. Contacts for the procurement of these oil barges are provided in the Gulf of Mexico lessees' OSCP's. It should be noted that offshore cleanup operations to open-water spills have, for the most part, been ineffective, as evident in the Alaskan oil spill response efforts. Despite the massive effort to cleanup the oil in Alaska, cleanup crews were able to recover no more than 15 percent of the spilled oil.

(5) Coastal Cleanup Techniques and Effects

Whenever possible, spill response should be carried out on water, as most equipment and techniques have been designed for such an approach. However, when a spill contacts a coastline, several techniques can be used. The selection of the type of treatment onshore will depend on the type and the amount of oil on the shore, the nature of the coast, the depth of oil penetration into the sediments, the accessibility and trafficability of the shoreline, and the possible ecological damage of the treatment to the shoreline environment (CONCAWE, 1981). The most suitable types of cleanup techniques to be used on a specific shoreline are shown on Tables IV-23 and IV-24.

Direct-Suction: If a beach, rocky area, or marsh has been contaminated with large volumes of oil and if the oil has pooled naturally in low spots or poorly drained areas, the use of direct suction can be a viable cleanup method. However, the effectiveness of this technique requires thick accumulations of oil. Direct suction can be accomplished with a pump, hoses, and a storage container. Recovered oil can be stored in metal storage containers, natural depressions lined with an impervious material, or a truck used for storing liquids. Another option is to use a vacuum truck equipped with a pump. Direct suction also can be applied to spills that have saturated porous soil types, such as sand and silt, by mechanically cutting a trench to act as a collection area for the oil (USDI, MMS, 1987d).

Manual Removal: Where oil contamination is low or sporadic, or when penetration of the oil into the sediment is low, manual removal of the oil is preferred. Manual removal usually is used to some extent on any shoreline cleanup, in combination with other techniques or alone. Due to logistical constraints or to access constraints placed on heavy equipment in some areas, manual recovery may be the only cleanup technique possible for some shoreline spills. This type of response is very time-consuming, costly, and labor-intensive; however, it might be the only way to deal with a spill. Manual removal is a very selective method of removing contaminated sediment and vegetation, making it an extremely effective response technique. The effectiveness of a manual response is directly related to the amount of time, labor, and money the operator wants to devote to the problem. The more money and time invested in a manual cleanup operation, the greater the amount of oil that may be recovered (USDI, MMS, 1987d).

Manual recovery involves the use of hand tools--such as rakes, shovels, buckets, pickaxes, brush cutters, scythes, and power brush-cutting tools--to remove contaminated sediment and vegetation. Oil-contaminated sediment or vegetation is collected and put into heavy-duty plastic or burlap bags for disposal. Bags may be removed manually, by vehicle, by boat or barges, or airlifted by helicopters to the disposal site (USDI, MMS, 1987d).

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Habitats

Method	Open Waters-Offshore/Nearshore	Open Waters-Enclosed Bays & Harbors	Soft Bottom-Subtidal	Seagrass Beds (Intertidal)	Seagrass Beds (Wade Zone Subtidal)	Rky Subtidal-Open Md-Bot. & Rocky Rfs.	Exposed Rock Intertidal	Sheltered Rocky Intertidal	Sandy Beaches (Exposed)	Sandy Beaches (Sheltered)	Sheltered Tidal Flats	Gravel/Cobble Beach (Exposed)	Sheltered Gravel Beaches	Sheltered Cobble Beaches	Coral Reefs (Lagoons)	Coral Reefs (Deep Fore, Flats, Crests)	Mangrove Forests	Salt Marshes
Beach Cleaning Machines									P	P								
Booms/Skimmers	P	P					V	P			P				P		P	P
Burial				A					A	A	A	A	A					
Burning	NA	NA					NA	NA	A	A			A		A	A	A	A
Dispersants	P	V		NA	NA		V	NA	V	A	NA	P	A	V	NA	V	P	V
Earth Barriers																		
Herding	V	V															V	V
High Pressure Flushing				A		NA	NA	NA	A	A	A	NA	A	NA			NA	A
Low Pressure Flushing				V	V		V	V		V	P	P	V	P		V	P	P
Management (Drainage)																	P	P
Manual Removal			V	NA	NA	NA	V	V	P	P	V	NA	P	NA	V		V	A
Natural Cleansing	p	P	P	P	P	PV	P	NA	P	V	P	P	NA	P	P	P	V	P
Sand Blasting							A					NA		A				
Sinking Agents	A	A																
Sorbents	V	V		NA	V	V	V	V	V	V	P	NA	V	V	V	NA	V	V
Steam Cleaning							A	A				A		A				A
Substrate Displacement				A					P	A	A	A		A				
Substrate Removal			NA	A			A	A	P	NA	A	A	NA	A			A	A
Vacuum Pumping	V	V	NA	A	A	V	V	V	P	P	V		P		P	V	V	V
Vegetation Cropping				A	NA		NA	NA										NA

P = Preferred
V = Viable
NA= Not Advisable
A = Avoid

Source: CSA, 1989.

Table IV-23. Summary of Cleanup Methods.

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Table IV-24

Shoreline Cleanup Methods

Method	Description	Applicability	Effect
High-pressure Hoses	- high-pressure stream of water washes oil from the substrate	- can be effective on rock, boulder, and manmade surfaces - oil flushed onto water surface for removal or channeled to beach collection site	- can damage flora and fauna - can flush oil into sediments - if beach is backed by unconsolidated cliffs, hosing of cliff can cause slumps, falls, or slope failure
Steam or Hot-Water Cleaning	- steam or hot-water washes oil from the substrate	- very effective on rock, boulder, and manmade surfaces - oil flushed onto water surface for collection or channeled to beach collection site - expensive method	- can be very harmful to flora and fauna - can flush oil into sediments
Sandblasting	- high-velocity sand removes oil from the substrate	- effective but slow method for rock, boulder, and manmade surfaces - can remove oil stains - expensive method	- can be very harmful to flora and fauna - scatters oil and sand - can cause deeper penetration of oil into sediments
Low-pressure Hoses	- low-pressure stream of water washes oil from the substrate	- effective but slow method for rock, boulder, and manmade surfaces - oil flushed onto water surface for collection or channeled to beach collection site	- biologically preferable to high-pressure hoses, steam cleaning, or sandblasting - can flush oil into sediments
Mixing	- A - mechanical equipment such as rakes, discs, or harrows used to break up oil cover and mix surface sediments	- accelerates natural cleaning - useful for light-grade oils or to break up "asphalt pavements" - increases surface area of exposed oil and increases dispersal and degradation rates	- does not remove oil - can cause burial of the oil

Table IV-24. Shoreline Cleanup Methods (continued)

Mixing	- B - mechanical equipment used to push oil/sediment down beach into water	- accelerates natural cleaning - wave action disperses and degrades oil - sediment is returned to the beach - applicable for "asphalt pavements" or coarse-sediment beaches	- does not remove oil - should not be used if storm waves are expected before sediment is returned to the beach; could result in waves overtopping the beach and/or causing backshore erosion
Removal			
Graders, Scrapers	- remove thin layer of oiled sediments - graders form windrows for scraper or front-end loader to remove - scraper removes oil/sediment layer directly	- effective on sand or pebble beaches with low oil penetration depths (less than 3 cm) - scraper can remove up to 25-cm layer of oil/sediment - some spillage which can be removed manually	- removes sediment from the beach, amount of sediment removed usually not sufficient to affect beach stability
Front-end Loaders	- loader removes material directly from beach to collection sites	- used on beaches with poor traction or for high oil penetration depths (25 cm or more) - high spillage - usually large amounts of uncontaminated sediment are recovered - rubber-tired vehicles are preferred to tracked vehicles	- can result in excessive sediment removal that could cause beach or backshore erosion - grinds oil into the beach
Bulldozers	- push material into collection sites for removal	- can remove oil/sediment where penetration is 25 cm or greater - not recommended unless other equipment unavailable or traction is too low for other equipment	- can result in excessive sediment removal that could cause beach or backshore erosion - large spillage and grinds oil into sediments
Dragline, Clamshell	- sediment collected in bucket dragged towards equipment, or by crane-operated bucket	- useful where beach access or trafficability is poor	- can result in excessive sediment removal that could cause beach or backshore erosion

Table IV-24. Shoreline Cleanup Methods (continued)

Sump Collection and Pump Removal	- sump excavated and used to collect oil, which is then removed by pump or vacuum systems	- useful for large spills with oil washed onshore over a period of days	- does not remove all the oil from the beach
Manual	- A - oil scraped from the substrate	- A/B - useful for areas inaccessible to equipment or small spills	- A - selective oil removal, not all oil is removed
	- B - oil collected with buckets, shovels, rakes, forks, etc. (with or without sorbents)	- A/B/C - labor-intensive methods; slow rate of oil removal	
	- C - cutting of oiled vegetation	- C - oil/vegetation collected in containers for removal	- C - labor-intensive method; pedestrian traffic can disturb marsh vegetation and can cause oil/sediment mixing
In Situ Cleaning			
Burning	- oil ignited, usually with ignition agents - continued burning may require wicking agents	- seldom completely successful - useful for oil on surface of ice - can be used in marshes with appropriate biological advice - oil residues remain	- causes heavy air pollution - can increase the penetration of oil into the sediments - can damage root systems of marsh vegetation
Beach Cleaning Machines	- cleaner picks tar lumps from the beach	- useful on beaches with tarballs	- little sediment removal

Source: USDI, MMS, 1987d.

Sorbents: Sorbent pads, booms, or rolls are often used as part of a manual response, or they can be used in conjunction with other techniques. Small, isolated pools of oil on the sediments or on nearshore waters can be removed by using sorbents. Once the sorbent materials have become soaked with oil, they can be removed by the methods described above, or they can be burned (USDI, MMS, 1987d).

Heavy Equipment: For certain areas, heavy equipment can be used as an effective cleanup technique. Its use would require either the availability of roads or a means of air-lifting or barging the equipment to the contaminated area. Only certain soil types, such as sand or rocks, could withstand heavy equipment. Graders, scrapers, loaders, bulldozers, and backhoes are equipment that may be used in cleaning up shoreline areas. This equipment can be used in areas where the soil-bearing capacity is adequate and habitats are not harmed by removal of soils (USDI, MMS, 1987d).

Flushing or Washing:

- *Low Pressure*: For cleaning light oils, such as fuel oil, from lightly contaminated sediments or vegetation, low-pressure flushing or washing can be a viable cleanup technique. In performing this operation, water is pumped from the ocean and is flushed over the lightly contaminated sediment to remove the oil. The removed oil is trapped downstream in a manmade trench or in a boomed-off area of the ocean close to shore. Once the oil is trapped, it can be removed by direct suction, skimming, burning, or sorbent pads. This technique is applicable only to shoreline areas because a nearby water source must be available. Additionally, this technique is easier to carry out if the trench or boom can be located downslope from where the flushing operations are being conducted.

  Low-pressure flushing or washing operations are extremely labor intensive and may damage the sediment by erosion or by driving the oil farther into the sediment. (USDI, MMS, 1987d).

- *High Pressure*: High-pressure flushing is basically the same technique as low-pressure flushing except that higher water pressures are used for high-pressure flushing. Typical specifications for high-pressure flushing are a 10-gallon-(0.04-m^3) per-minute flow rate at 4,000 pounds per square inch (272 atm). The penetration of oil deeper into the sediment with high-pressure flushing is an even greater danger than for low-pressure flushing (USDI, MMS, 1987d).

Steam Cleaning and Sandblasting: Steam cleaning and sandblasting are techniques that can be used to remove oil from rocks, boulders, and manmade structures. These techniques use high-pressure jets of steam or sand to physically remove oil from the contaminated surface. Care must be taken in using these techniques because the high-pressure streams can severely erode the sediment or damage any uncontaminated flora or fauna in the area (USDI, MMS, 1987d).

Natural Dispersion: Another option in dealing with shoreline cleanup that could prove very effective in certain environments is natural dispersion. For contaminated shorelines close to high-energy ocean environments--such as sand, gravel, or cobble beaches--natural dispersion of the oil into the ocean could be very effective. Natural dispersion may be the only possible alternative when logistics or weather problems preclude a response effort (USDI, MMS, 1987d).

e. Response Options for Handling Oiled Wildlife and Birds

Rehabilitation of oil-contaminated wildlife may be necessary to protect species that are endangered or of high aesthetic value. Successful programs are very labor intensive and have relied mostly on volunteer labor. Some of the studies that have been done regarding the effects of oil on marine mammals indicate that a few mammal species may rid themselves of oil by washing. Animals that groom themselves may ingest oil, which can result in mortality of the animal. Rehabilitation efforts may also stress certain animals, causing increased mortality and behavioral changes. Rehabilitation programs require extensive manpower to locate, capture, treat, and care for oiled wildlife. The success of such a program will be dependent upon the number of animals involved, the extent of oiling, the physiological condition of the animals, and the experience of the people undertaking the rehabilitation program (USDI, MMS, 1987d).

The RCP for Coast Guard Region VI contains Annex 7, which recognizes the importance of responding to contamination of waterfowl and which designates the FWS and names contacts for initiating bird collection and cleaning activities. The RCP for Coast Guard Region IV contains no special Annex but lists the NPS and FWS as contacts for responding to potential impacts to sensitive resources, including bird rookeries, which are used at the time of an oil spill to determine where lines of response should be placed.

Because of the less confined nature of coastlines and marshes, aircraft would probably be of most value for the initial dispersal of birds. If the section of coastline that was oiled or about to be oiled was extensive, use of aircraft would probably be the only practical dispersal method, and numerous aircraft would be necessary.

Deterrent methods and devices would need to be deployed along the shore in order to prevent birds from entering the contaminated water. Shell crackers, exploders, lights, reflectors, and mortars, together with continued use of aircraft, would be standard approaches. Distress and alarm calls would be useful if calls of the appropriate species existed and were available. The major limiting factors would be the logistical problems of deploying and operating a sufficient number of devices (Koski and Richardson, 1976).

The most effective dispersal method offshore would probably be the use of aircraft. However, some species of seabirds are more likely to dive than to fly when an aircraft approaches, and some moulting waterfowl would be unable to fly. Low-altitude (effective) operations would be impossible at night. Searchlights mounted on boats and mortars, rockets, flares, and shell crackers fired from boats would be useful at night, but their effectiveness in cases of large spills would be limited. Because of their large area of coverage, rockets and mortars would probably be more useful than shell crackers and flares both by day and by night. Clean Gulf Associates currently stockpiles a total of 10 sets of 12 bird scare guns strategically located at their bases in Port Aransas and Galveston, Texas; Intracoastal City, Venice, and Grand Isle, Louisiana; and Panama City, Florida. It is recommended that this equipment be manned continuously and that the guns be alternately turned on and off every hour in order that their use would remain effective in scaring birds from oiled areas.

It is possible that creation of lure areas away from the contaminated area might attract birds out of the hazardous zone. The obvious approach would be to feed seabirds by throwing fish and other foods into the sea from a boat. However, it is quite probable that this would attract more birds into the general area of the oil spill and ultimately increase rather than decrease mortality. It is also possible that boats working in or near the spill for cleanup or even deterrent purposes might unintentionally attract seabirds, which commonly fly toward boats (Koski and Richardson, 1976).

The FWS has designated contacts in Clear Lake, Texas; Lafayette, Louisiana; Daphne, Alabama; and Panama City, Florida, who act as field coordinators for any waterfowl-rehabilitation actions. These coordinators can call upon the services of any local FWS office for assistance and equipment. The FWS also maintains a dedicated spill-response trailer in Daphne, Alabama, which contains equipment needed to prevent bird contamination or to care for oiled birds. This center serves the Gulf Coast region and can be relocated to a spill site upon demand. The FWS in Texas has an extensive oiled bird-rehabilitation program and has stockpiled specialized equipment in Aransas, Laguna Madre, Anahuac, and Galveston, Texas. The CGA has a movable waterfowl rehabilitation station located in Grand Isle, Louisiana. Extensive information on the use of this rehabilitation station is provided in Volume I of the CGA Operations Manual (CGA, 1989b). This waterfowl rehabilitation station has physical space inside for up to two dozen birds, depending upon the species, degree of recovery, and aggressiveness. If it is decided to expand the station, then up to 200 game-size birds can be accommodated. The expanded, fenced enclosure will accommodate several hundred more. The CGA station is designed to complement a larger and more permanent facility that would be established based upon the siting, personnel, and equipment guidelines recommended by the International Bird Rescue Center of Berkley, California. Approximately 350 gallons of a recommended cleanser, enough to cleanse 1,000 birds, is stockpiled by CGA.

Survival of rehabilitated oiled birds may vary from 30 percent (Sims, 1970) to 90 percent (Mueller and Mendoza, 1983). The success of rehabilitation is primarily due to three factors: advance preparation in stockpiling supplies and training volunteers; the availability of a cleanup station with adequate indoor space, hot running water, and outdoor pens; and, most importantly, the efforts and cooperation of willing volunteers and the government agencies involved (Mueller and Mendoza, 1983).

f. Recent Developments in Spill-Response Planning/Capabilities

National Response Team

In May 1989, the National Response Team issued its Report to the President on the *Exxon Valdez* spill (Skinner and Reilly, 1989). Besides summarizing the status of the spill, the NRT identified actions that they felt should be taken to improve the nation's preparedness for spill response. They recommended a better response coordination between Federal, State, and local authorities, especially in regard to the concerns of States; that the National Contingency Plan needs to be changed; that oil spill planning should better incorporate the care of wildlife and should prepare for and mitigate for wildlife impacts; that exercises to test contingency plans should be conducted; and that more research should be conducted into improving cleanup technology. The NRT, under the leadership of the USCG, is finalizing a nationwide review of contingency plans by the entire Federal Government, including the 14 agencies that makeup the NRT and all of the U.S. Coast Guard's RRT. The review, which will include a total of 75 reports from these various agencies, is directed toward examining the use of worst-case scenarios to ensure realistic planning, examining the adequacy of equipment and personnel for an effective response, and the importance of well-defined organizational responsibilities.

Minerals Management Service

On April 18, 1989, the Secretary of the Interior directed MMS to review current oil spill planning, response requirements, and practices for OCS oil and gas operations. Based on this review, the following recommendations were made:

(1) The MMS should develop minimum performance requirements for response equipment once standard test protocols are established.

(2) The MMS should develop regional guidelines for equipment inspections.

(3) The MMS should develop regional guidelines for reviewing and approving OSCP's.

(4) The MMS should establish a standard test protocol for offshore-containment booms and should propose equipment-test requirements.

(5) The MMS should adopt its existing oil-skimmer test protocol and require testing by industry.

(6) The MMS should review all OSCP's to ensure an appropriate response to the largest possible OCS oil spill.

(7) The MMS should develop more extensive oil spill drill programs.

The following recommendations, resulting from the review of OCS industry-response capabilities, were specifically directed towards the MMS Gulf of Mexico OCS Regional Office:

(1) The Gulf Office should assess oil spill response times on a case-by-case basis for their adequacy in the light of potential damage and should consider the establishment of response zones.

(2) The Gulf Office should develop a plan for unannounced drills involving full deployment of equipment.

The MMS has undertaken a number of measures in response to these recommendations.

On April 18, 1989, MMS announced that they will be conducting a stepped-up series of surprise visits by inspectors to OCS drilling rigs and production platforms.

On May 30, 1989, MMS informed industry through a Letter-to-Lessees that unannounced drills would occur. Recently, the MMS, Gulf of Mexico OCS Regional Office, finalized procedures for various types of oil spill response drills and initiated the unannounced drill program.

The MMS has initiated a $6 million research program on oil spill technology research, sharing the funding evenly with the American Petroleum Institute. Specifically, research will be conducted on oil spill detection, containment, and cleanup technology. As of April 27, 1990, the management of the Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) located in Edison, New Jersey, was transferred to MMS for purposes of research to improve oil-spill response and capability; it is scheduled to reopen in early 1991. The reactivation of this facility will allow the development of standard testing protocol to determine the efficiency and effectiveness of response equipment and products, such as skimmers and dispersants.

The MMS has also recently developed guidelines for equipment inspections and for reviewing and approving OSCP's. All OSCP's have been reviewed to ensure an appropriate response to the largest possible OCS oil spill. The Gulf Office is currently assessing oil spill response times on a case-by-case basis for adequacy in the light of potential damage and is considering measures such as the use of identified and equipped vessels at designated sites offshore to reduce response times in the Gulf of Mexico.

American Petroleum Institute

In its report of June 14, 1989, the American Petroleum Institute's oil-spill task force announced that it would be spending an initial estimated $250 million during the next 5 years to prevent and remove catastrophic oil spills and to conduct spill-related research. The original $250 million has since been increased to approximately $393 million. The plan establishes a new Petroleum Industry Response Organization (PIRO), with a small headquarters office in Washington, D.C., five regional offices, 19 sites for prepositioned materials. New Orleans was originally being considered as the site of one of the regional offices; however, sites in the Houston, Galveston, and Port Arthur, Texas, areas are now being considered as they are more centrally located to the entire area and are not located as far from the Gulf as New Orleans. Under the plan, equipment will be stationed at major U.S. ports to attempt control of a 216,000-bbl open sea spill. The task force also plans to spend $30-35 million during 5 years on spill research and development in such categories as prevention of oil loss from/away from ships, on-water oil recovery and treatment, prevention and mitigation of shoreline impact, oil in water fate and effects research, wildlife research, and worker health and safety. It is presently hoped to have PIRO in initial operational capacity 12 months after the pending oil spill legislation becomes law and to have the full system operational 12 months thereafter. If Congress approves an unlimited liability clause for shipowners and spill-reposnse organizations, PIRO will probably only stockpile equipment for rental use. As of April 1990, 25 U.S. companies have joined PIRO.

END

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